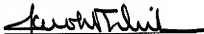


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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant: Irving W. DeVoe
Application Serial No.: 10/626,209
Filed: July 24, 2003

Confirm. No.: 9677
Group Art Unit: 1797
Examiner: Krishnan S. Menon

Title: SYSTEM AND METHOD FOR CONVERTING KINETIC ENERGY
OF GASES OR LIQUIDS TO USEFUL ENERGY, FORCE AND WORK

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APPEAL BRIEF

Sir:

This is an appeal from the final Office Action dated December 15, 2008 rejecting claims 42, 47-48, 50-52, 68 and 71 in the above-identified application. A Notice of Appeal was timely filed on May 15, 2009 and a one month extension of time was timely filed under 37 C.F.R. §1.136(a) on July 14, 2009 together with the appropriate fee, and therefore this Appeal Brief is timely filed and is accompanied by the appropriate current small entity fee under 37 CFR 1.17(c).

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REAL PARTY IN INTEREST

The real party of interest is the Assignee, Effusion Dynamics, LLC, having offices at Boston, Massachusetts.

RELATED APPEALS AND INTERFERENCES

None.

STATUS OF CLAIMS

Claims 42, 47-48, 50-52, 68 and 71 remain pending in this application. The claims currently on appeal are claims 42, 47-48, 50-52, 68 and 71. No claims were allowed. Claims 42, 47-48, 50-52, 68 and 71 were finally rejected. A copy of the claims on appeal is provided in the Claims Appendix.

STATUS OF AMENDMENTS

A Response to Final Office Action Under 37 C.F.R. 1.116, which contained remarks presenting reasons for allowance of the claims, as well as a supplemental Information Disclosure Statement (IDS), was filed on May 8, 2009. The Examiner issued an Advisory Action dated May 15, 2009 which stated that he considered the response but had not found it persuasive. The IDS submitted by Appellants was initialed by the Examiner and the initialed copy of the IDS was attached to the Advisory Action.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claims 42 and 50, and dependent claims 47-48, 51-52, 68 and 71 are involved in this appeal.

Independent claim 42 claims a method of producing energy, and includes the following steps: 1) providing a sealed first chamber (20) (shown but not limited to Figs. 1, 2A, 3 and 6 and described but not limited to pg. 2, lns. 17, 18; pg. 4, ln. 21; pg. 9, lns. 16, 17; pg. 13, ln. 22 describing a closed solvent chamber (20); pg. 20, ln. 22 describing closed solvent chamber (20) being sealed); 2) providing a sealed second chamber (30) (shown but not limited to Figs. 1, 2A, 3, 6, 7 and 9 and described but not limited to pg. 2, ln. 18; pg. 4, lns. 21, 22; pg. 9, lns. 17, 18; pg. 21, lns. 11 and 12 and 30, 31 describing the pressure chamber (30) being closed and sealed); 3) providing a semi-permeable barrier (40) separating the first chamber (20) from the second chamber (30) (shown but not limited to Figs. 1, 2A, 3, 6 and 9 and described but not limited to pg. 2, lns. 18, 19; pg. 4, lns. 22, 23; pg. 9, lns. 18, 19; pg. 20, lns. 11, 12); 4) filling the first chamber (20) with a solvent (shown but not limited to Figs. 1, 2A, 3 and 6 and described but not limited to pg. 4, ln. 23); 5) filling the second chamber (30) with a solute solution comprising a solute and solvent (shown but not limited to Figs. 1, 2A, 3 and 6 and described but not limited to pg. 4, lns. 23 and 24); 6) providing communication (200) between the solvent solution and solute solution to cause the solvent to flow from the first chamber through the semi-permeable barrier (40) into the second chamber (30) (shown but not limited to Figs. 1, 2A, 3, 6 and 9 and described but not limited to pg. 2, lns. 18-23 describing that solvent molecules effusing across the semi-permeable barrier; pg. 4, lns. 24-26; pg. 9, lns. 24-27); 7) utilizing the semi-permeable barrier (40) to restrict solute from flowing into the first chamber while allowing the solvent to flow into the second chamber (30) as the solvent flows from the first chamber (20) into the second chamber (30) a void is created in the first chamber (20) such that a vacuum develops in the first chamber (20) and increases the pressure in the second chamber (30) (shown but not limited to Figs. 1, 2A, 3, 6 and 9 and described but not limited to pg. 2, lns. 8-15; pg. 9, lns. 18-30, which describes the restriction of solute and flow of solvent; and pg. 13, lns. 21-27, which describes the creation of a void/vacuum); 8) periodically applying and removing the increased pressure to drive a member (78) which produces a movement from which work can be extracted

(shown but not limited to Figs. 4, 6, 7 and 9 and described but not limited to pg. 21, lns. 9-11 where valves 311, 34 and 310 may selectively open and close; pg. 22, lns. 24-32; pg. 23, lns. 23-29 where pistons 69a, 69b, 69c move forward and backward operated from the pressure chamber (30) in conjunction with the synchronized opening and closing of flow control valves 311a, 311b, 311c); 9) removing a portion of the solute solution from the second chamber (30) and transferring the removed portion of the solute solution into a third chamber (56) (shown but not limited to Figs. 5, 6 and 9 and described in, but not limited to, pg. 25, lns. 10-13 where the third chamber (56) is blowdown receiving chamber 56); 10) applying energy (560) to the removed portion of the solute solution in the third chamber (56) thereby vaporizing the solvent contained in the removed portion of the solute solution and thereby separating the solute in the removed portion of the solute solution (shown in, but not limited to, Figs. 5, 6 and 9, and described but not limited to pg. 3, lns. 21-30; pg. 18, lns.3-14; pg. 19, lns.14-16, where a heating coil 560 produces energy to vaporize the solvent); and 11) recycling the separated solute to the second chamber (30) (shown, but not limited to Figs. 5, 6 and 9, and described, but not limited to pg. 3, lns. 21-30; pg. 18, lns.12-14, where the recycling operation is described.)

Independent claim 50 claims a method of producing a linear displacement of an object, and includes the following steps: 1) providing a sealed first chamber (20) (shown but not limited to Figs. 1, 2A, 3 and 6 and described but not limited to pg. 2, lns. 17, 18; pg. 4, ln. 21; pg. 9, lns. 16, 17; pg. 13, ln. 22 describing closed solvent chamber (20); pg. 20, ln. 22 describing closed solvent chamber (20) being sealed); 2) providing a sealed second chamber (30) (shown but not limited to Figs. 1, 2A, 3, 6, 7 and 9 and described but not limited to pg. 2, ln. 18; pg. 4, lns. 21, 22; pg. 9, lns. 17, 18; pg. 21, lns. 11 and 12 and 30, 31 describing the pressure chamber (30) being closed and sealed); 3) providing a semi-permeable barrier (40) separating the first chamber (20) from the second chamber (30) (shown but not limited to Figs. 1, 2A, 3, 6 and 9 and described but not limited to pg. 2, lns. 18, 19; pg. 4, lns. 22, 23; pg. 9, lns. 18, 19; pg. 20, lns. 11, 12); 4) filling the first chamber (20) with a solvent (shown but not limited to Figs. 1, 2A, 3 and 6 and described but not limited to pg. 4, ln. 23); 5) filling the second chamber (30) with a solute solution comprising a solute and solvent (shown but not limited to Figs. 1, 2A, 3 and 6 and described but not limited to pg. 4, lns. 23 and 24); 6) providing communication (200) between the solvent solution and solute solution to cause the solvent to flow from the first chamber (20) through the semi-permeable barrier (40) into the second chamber (30) (shown but not limited to

Figs. 1, 2A, 3, 6 and 9 and described but not limited to pg. 2, lns.18-23 describing solvent molecules effusing across the semi-permeable barrier (40); pg. 4, lns. 24-26; pg. 9, lns. 24-27); 7) utilizing the semi-permeable barrier (40) to restrict solute from flowing into the first chamber (20) while allowing the solvent to flow into the second chamber (30) as the solvent flows from the first chamber (20) into the second chamber (30) a void is created in the first chamber (20) such that a vacuum develops in the first chamber (30) and increases the pressure in the second chamber (shown but not limited to Figs. 1, 2A, 3, 6 and 9 and described but not limited to pg. 2, lns. 8-15; pg. 9, lns. 18-30, which describes the restriction of solute and flow of solvent; and pg. 13, lns. 21-27, which describes the creation of a void/vacuum); 8) periodically applying and removing the increased pressure to drive a member (78) which produces a substantial linear displacement of the object (the power-generating system includes a plurality of hydraulic pistons 69a, 69b, 69c, as shown in Fig. 7 in communication with the pressure chamber (30). The pistons 69a, 69b, 69c, operated from the pressure chamber (30), move forward and backward in conjunction with the periodic application and removal of increased pressure effected by the synchronized opening and closing of flow-control valves 311a, 311b, 311c in connecting channels 307a, 307b, 307c, respectively. An external electronic controller (not shown) selectively opens and closes the flow-control valves. The illustrative hydraulic pistons 69a, 69b, 69c may, but are not limited to, driving a three-piston engine block 690, which is connected to a gear box 691 used to power a device 70); 9) removing a portion of the solute solution from the second chamber (30) and transferring the removed portion of the solute solution into a third chamber (56) (shown but not limited to Figs. 5, 6 and 9 and described in, but not limited to, pg. 25, lns. 10-13 where the third chamber (56) is blowdown receiving chamber 56); 10) applying energy (560) to the removed portion of the solute solution in the third chamber (56) thereby vaporizing the solvent contained in the removed portion of the solute solution and thereby separating the solute in the removed portion of the solute solution (shown in, but not limited to, Figs. 5, 6 and 9, and described but not limited to pg. 3, lns. 21-30; pg. 18, lns.3-14; pg. 19, lns. 14-16, where a heating coil 560 produces energy to vaporize the solvent); and 11) recycling the separated solute to the second chamber (30) (shown, but not limited to Figs. 5, 6 and 9, and described, but not limited to pg. 3, lns. 21-30; pg. 18, lns.12-14, where the recycling operation is described).

In summary, but not limited thereto, the methods of producing energy and for producing linear displacement of an object of the claimed invention comprises a sealed solvent chamber (20) for holding a solvent solution, and a sealed pressure chamber (30) for holding a solute solution. A semi-permeable barrier (40) separates the solvent chamber (20) from the pressure chamber (30). The barrier (40) is permeable to solvent molecules, such as water molecules and other small solvents, and impermeable to solute molecules, to allow the flow of solvent molecules across the barrier while blocking solute molecules from passing through the barrier. According to the illustrative embodiment, the solvent solution in the solvent chamber (20) and the solute solution in the pressure chamber (30) have different concentrations. The difference in concentration between the solvent solution and the solute solution results in the effusion of the solvent molecules from the solvent chamber (20) across the semi-permeable barrier (40) into the solute solution of the pressure chamber (30). When the pressure chamber (30) is closed or sealed, the net unidirectional solvent flow from the solvent chamber (20) into the pressure chamber (30) progressively increases the kinetic energy in the pressure chamber (30), i.e., produces an increase in hydrostatic pressure. The pressure in the pressure chamber progressively rises until the hydrostatic pressure becomes sufficient, i.e., equal to or greater than the osmotic pressure, to stop the net unidirectional flow of solvent across the semi-permeable barrier (40) into the pressure chamber (30).

To produce and maintain a vacuum, the solvent chamber (20) is closed, has a defined volume, and contains a volume of solvent at the start of operation. The crossing of the solvent across the semi-permeable barrier (40) into the pressure chamber (30) due to osmosis causes a progressively decreasing pressure (vacuum) in the progressively enlarging void space 20v above the solvent in the solvent chamber (20).

The pressure increased in the pressure chamber (30) due to the diffusion of solvent through the semi-permeable barrier (40) exerts pressure on the diaphragm (67). The diaphragm (67) separates the pressure chamber from hydraulic fluid (68), which is connected to a first piston (69) in a first cylinder (62). In response to deflection of the diaphragm (67) due to an increase in pressure in the pressure chamber (30), the hydraulic fluid (68) pushes the first piston (69) forward, which in turn moves a second, larger piston (64) in a second cylinder (63). The larger surface area of the second piston (64) forces the hydraulic fluid (71) into a third cylinder (75) having a smaller diameter. The third cylinder (75) in turn drives a push rod (78) forward. The

push rod (78) moves faster relative to the first piston (69). After the push rod (78) moves fully forward, due to the increased pressure in the pressure chamber (30), the push rod (78) reciprocates back to a starting position.

A recycling system (50) includes a blowdown receiving chamber (56) for receiving the exhausted solute and solvent. The blowdown receiving chamber (56) vaporizes the solvent in the exhausted solute solution. Energy is utilized in the form of any suitable means, such as a heating coil (560), and may be used to vaporize the solvent. Preferably, the blowdown receiving chamber (56) dries the solute in the exhausted solute solution to a dry form and then introduces the dried solute back into the pressure chamber (30) at designated intervals by any appropriate transfer means. After vaporization, the vaporized solvent passes into a condenser (57), which condenses the vaporized solvent from the vapor state to a liquid state. The liquid solvent then circulates to the solvent chamber (20), where the energy producing process repeats using the recycled solvent and solute.

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

Claims 42, 47, 48, 50-52, 68, and 71 were rejected under 35 U.S.C. §102(b) as being anticipated by, or, in the alternative, under 35 U.S.C. §103(a), as being obvious in light of Loeb (U.S. Patent No. 3,906,250) (hereinafter, "Loeb").

Claims 42, 47-48, 50-52, 68, and 71 were rejected under 35 U.S.C. §102(b), as being anticipated by, or, in the alternative, under 35 U.S.C. §103(a), as being unpatentable over the German Patent No. DE 3121968 ("DE" or "the DE reference") for which an English translation was provided in the record by the Examiner.

ARGUMENT

The issues on this appeal relate to anticipation and obviousness based on standards of the patent law.

To aid the Board of Patent Appeals and Interferences (BPAI), Appellant provides in the Evidence Appendix Exhibit A, a Declaration under 37 CFR 1.132 by the inventor, Irving DeVoe, PhD ("DeVoe"), dated November 30, 2008 and submitted by Appellant to the USPTO with the Appellant's Response dated December 1, 2008, and by expert Professor William Grant McGimpsey, Ph.D. ("McGimpsey") under 37 CFR 1.132 as Exhibit B dated November 26, 2008 and submitted by Appellant to the USPTO with the Appellant's Response dated December 1, 2008.

I. Claims 42, 47, 48, 50-52, 68, and 71 were rejected under 35 U.S.C. §102(b) as being anticipated by, or, in the alternative, under 35 U.S.C. §103(a), as being obvious in light of Loeb (U.S. Patent No. 3,906,250) (hereinafter, "Loeb").

Appellant respectfully contends that the comments below provide sufficient reasons to support that claims 42 (independent), 47, 48, 50 (independent), 51, 52, 68 and 71 are patentable over Loeb and the Examiner's 35 U.S.C. §§102 and 103 rejections are in error.

More specifically, Loeb fails to show or describe the following, but not limited to, method steps of producing energy (independent claim 42) and of producing linear displacement of an object (independent claim 50):

- 1) providing a sealed first chamber;
- 2) providing a sealed second chamber;
- 3) utilizing the semi-permeable barrier to restrict solute from flowing into the first chamber while allowing the solvent to flow into the second chamber as the solvent flows from the first chamber into the second chamber a void is created in the first chamber such that a vacuum develops in the first chamber and increases the pressure in the second chamber; and
- 4) periodically applying and removing the increased pressure to drive a member (which produces a substantial linear displacement of an object-as in claim 50).

By not describing, disclosing or showing the above steps, Loeb clearly cannot be utilized to support a 35 U.S.C. §102 rejection; and without any teaching (no secondary reference is

utilized by the Examiner) or indication of how official notice can be taken to meet these limitations without destroying the intended operation of Loeb, Loeb cannot be utilized by the Examiner in a 35 U.S.C. §103 rejection of the claims. The below arguments for patentability with respect to Loeb also refers at times to the German (DE reference) patent since Loeb and the DE reference are quite similar. More details with respect to the DE reference are also provided in the specific rebuttal thereof provided later in this brief.

In support of Appellant's position, and particularly in rebuttal of the Examiner's allegations in the Final Rejection of the claims, Appellant presents the following:

The Examiner alleges that:

Loeb '250 teaches (see Figs.) a method of producing energy from a system having a semipermeable barrier separating a pressure chamber and a solvent chamber, wherein the pressure chamber has a solution (sea water) and solvent chamber has a solvent (river water), the solvent flows from the solvent chamber to the pressure chamber across the membrane, and the solvent chamber thus would inherently have a reduced pressure or even vacuum. See also Figure 11, which is a closed system with the solvent chamber having only inflow, wherein the solvent chamber is at zero pressure. The solute solution is evaporated with external heat (like solar) in a third chamber—see figure 6 for example—and the solute is recycled as a concentrated solution.

With respect to the limitation, "utilizing the semi-permeable barrier to restrict solute from flowing into the first chamber while allowing the solvent to flow into the second chamber as the solvent flows from the first chamber into the second chamber a void is created in the first chamber such that a vacuum develops in the first chamber and increases the pressure in the diluted solute solution in the second chamber," the creation of the void and the increase in pressure in the diluted solution in the second chamber are inherent in the process of natural osmosis and are not patentable process steps (underlining added by Examiner).

Periodically applying and removing pressure to drive a member to produce movement is taught by the reference – see the Figs. for the various energy conversion schemes. The 'periodically applying' can mean anything from occasional start stop to a reciprocating system, and such schemes of energy conversion are within the capability of one of ordinary skill in the art to design.

With respect to claim 50, a displacement of an object, such as a piston, is implied in the reference to a piston in column 11, lines 37-59.

The solvent chamber is pressurized by pumps.

(Sec pages 2-3 of the Examiner's Final Rejection dated December 15, 2008.)

Appellant contends that Loeb's patent describing the use of continuous flow in a pressure retarded osmosis (PRO) system is in stark contrast to Appellant's claimed invention of "providing a sealed, first chamber; providing a sealed second chamber;...periodically applying and removing the increased pressure..." For example, Loeb discloses "A volume $(V+\Delta V)$ m³ of mixed solution is sent to the hydroturbine 126 at a pressure of P_{atm} . Thus the hydroturbine delivers $P(V+\Delta V)$ m³ of work (via the connection 129) in the course of reducing the pressure of the mixed solution to zero. The new output of work is equal to the difference between the output from the hydroturbine and the input to the pump, i.e., the net work is $(P\Delta V)$ m³ atm." It is important to understand that net work is obtained in Loeb only from ΔV , the volume of permeant liquid passing through the membranes." See Loeb, col. 12, lines 41-54.

It is clear that a patentable distinction between Appellant's claimed invention and Loeb (and the DE reference) resides in Appellant providing a pair of sealed containers which cause the (osmotic) pressure to increase as the solvent passes through the membrane. Appellant's claimed invention produces useable energy output when pressure is periodically applied and removed from the pressure chamber as claimed. (Underlining added.) These steps are clearly lacking in Loeb (and the DE reference).

With respect to the Examiner's comments related to "Periodically applying can mean anything..." this is an incorrect statement since nowhere in Loeb does Loeb speak of a periodic application or removal of pressure. In fact, on the contrary, Loeb uses a continuous flow of solvent and solute and relies on an increase in volume rather than, as Appellant claims, "periodically applying and removing the increased pressure to drive a member which produces a movement from which work can be extracted." (Independent Claim 42) or "... substantial linear displacement of the object." (Independent claim 50)

In order to further clarify why Loeb (and the DE reference) does not periodically apply and remove pressure, Appellant refers the BPAI to the figures of Loeb. In particular, the pressure retarded osmosis system of Loeb is described in greatest detail with respect to Figs. 1, 2a, 2b, 3, 3a, 4, 4a, 5, and 6. In particular, each of these figures indicates that an external hydraulic pressure P is applied to the surface of the sea water 6 via a pump 16, 26, 66, or 36. This pressure is used to slow the flux of the permeant, fresh water, into the sea water (see Loeb, Eqs 1 and 2). This is necessary in Loeb (and the DE reference), to allow the increased volume, ΔV to be used

to provide the additional energy to drive the turbine 17, 27, 67, and 37, 47, and 57. Clearly, the pressure retarded osmosis system of Loeb (and the DE reference), which uses continuous flow is different than Appellant's claimed inventions and methodology. (Underlining added).

It is important to note that the term "periodically" is not used in the Loeb patent at all. On the contrary, the Loeb system is described as a continuous system in the brief description of the drawings for Figs. 3 and 4 (see Loeb, col. 3, lines 19-26). The Loeb patent also uses the term continuous in the description accompanying Figs. 2a and 2b (see Loeb col. 4, lines 45-53). In addition, the Loeb patent describes the process as continuous in the description of Figs. 3 and 3a (see Loeb, col. 4, lines 56-60). In addition, it is clear when discussing the operation of the pressure retarded osmosis system or apparatus, that both the brine and the river water both have inlets and outlets (see Figs. 3, 3a, 4, 4a, 5, 5a, and 6).

Moreover, Loeb, in column 4, lines 25-27, identifies the various pressures of liquid represented in the figures. In particular, the "P" in the figures is identified as hydraulic pressure and π is identified as the osmotic pressure of the fluids in the system. Thus, the hydraulic pressure, P, of the fluid may be zero atm, i.e., there is no hydraulic pressure being exerted on the body of fluid. Contrary to the Examiner's allegations, zero atm hydraulic pressure does not imply a vacuum as in the claimed invention. Rather, in Loeb, zero atmospheres (atm) means that the fluid is not under any hydraulic pressure, i.e., the fluid is not being pumped. As is well known in the art, atm is a unit of pressure, i.e., atmospheres, and is not indicative of the atmospheric pressure on the solution, i.e., that zero atm would not be equal to a vacuum.

Accordingly, when Loeb is discussing pressure, Loeb is referring to the hydraulic pressure of the fluids in the system and uses atmospheres as the units and zero atmospheres is indicative of unpressurized fluid and not a vacuum that is created by the device as in the claimed invention. Thus, the Appellant's assertion that Loeb fails to teach a vacuum as produced and used in the claimed invention is supported by the specification and figures of Loeb.

In Loeb, the addition of mechanical energy to the system is provided by adding more water volume to the system, thereby increasing its energy, and not by increasing pressure as in the claimed invention. In Loeb, the sea water (solute) is maintained at a constant and elevated hydrostatic pressure P by pump 122. Additional mechanical energy is then provided to the solute liquid by the inclusion of additional volume to the constant pressure and the extra energy is given by $W=P\Delta V$, where P is the hydrostatic pressure provided by pump 122 and ΔV is the additional

solvent volume added to the solute via the river water passing through the semipermeable membrane. See Loeb, col. 12, lines 40-45. Thus, Loeb adds additional fluid volume (solvent) to the solute fluid in the system to add additional energy to the solute fluid, albeit by diluting the solute. Thus, as the solute flows through the system, solvent is added thereto and the increased volume, i.e., the increased mass of water, flows at an increased rate, thereby having an increase in energy. More specifically, and in rebuttal to the Examiner's rejection of the claims, Loeb teaches in column 4, lines 35-44 that: "[t]he volume under a pressure P, will increase on the sea water side 6 (Fig. 2b). ... the energy furnished will exceed the energy (work) originally done on the sea water by a fraction $\Delta V/V$ where ΔV is the volume of permeant (solvent) which has passed through the membrane and V is the original volume of sea water. The excess mechanical energy is given by $P\Delta V$."

Thus in Loeb, it is the extra volume of solvent added to the solute solution that provides the energy in Loeb and the hydraulic pressure P remains substantially constant. As Figs. 2a and 2b in Loeb show the hydraulic pressure added, $P < \pi$, allows the solvent, fresh water, to flow into the second chamber, 6, increasing the volume from $V = m^3$ to $(V + \Delta V) m^3$.

The Examiner has also asserted that Loeb teaches that a vacuum is produced in the Loeb system. This is incorrect. In Loeb, the V-P diagrams shown in Figs. 3a and 4a indicate that there is no vacuum produced by the device taught in Loeb. The pressure depicted in the graph is hydraulic pressure and thus, zero pressure is not a vacuum but unpressurized fluid. As Loeb states in col. 5, lines 19-44:

As one example, 1 cubic meter of sea water (as a basis) at zero atmospheres hydraulic pressure and 25 atmospheres osmotic pressure (Point A in Figs 3 and 3a) is compressed by pump 16 to 10³ atmospheres hydraulic pressure (Point B) thus absorbing mechanical energy equal to $(1)(10) = 10$ cubic meter-atmospheres ($m^3 \text{ atm}$) or 0.28 kilowatt hours (KWH) (Area ABEF in FIG 3a. The sea water is then passed through pathway 14 of the PRO apparatus 10 at the hydraulic pressure of 10 atmospheres in counterflow to the river water at zero hydraulic pressure flowing through pathway 18 on the other side of membranes 12. The sea water absorbs $0.6 m^3$ of permeant through the membranes. Thus $1.6 m^3$ of diluted brine leave the PRO apparatus at a hydraulic pressure of 10 atmospheres (Point C). As the sea water passes through hydroturbine generator 17, its hydraulic pressure is released to zero (Point D) in the process of delivering $(1.6)(10) = 16 m^3 \text{ atm}$ or .45 KWH of energy (Area CDEF in FIG 3a)....

Although the solvent will flow across the semipermeable barrier, there is no teaching in Loeb of a vacuum or reduced pressure in any of the various embodiments of the PRO engine disclosed within Loeb. See Loeb, the entire document.

It is also important to note that the figures of Loeb are described as being block diagrams, and cannot therefore be thought of as physically representative of the system without further descriptions. A block diagram cannot alone be relied upon to show a closed system or an open system. Given that there is no mention of a vacuum in the low hydraulic pressure side of the PRO engine, it is not logical to assume that any vacuum is produced. In addition, the lower hydraulic pressure side of the PRO engine is to be maintained as a low hydraulic pressure side, and if river water is continuously pumped into this side (by a pump) (see Loeb, col. 12, lines 30-35), as is taught, the side cannot be closed as the hydraulic pressure would increase. Thus, it is not logical to assume that a vacuum is provided for in Loeb. Appellant points out there is no specific language and examples of vacuum being provided for in the solvent side of the PRO engine in the Loeb reference. On the other hand, Appellant's specification (as pointed out above in the SUMMARY OF THE CLAIMED INVENTION) clearly describes the closed or sealed chambers and vacuum.

The Examiner further asserts that Figure 11 of Loeb teaches a closed system with the solvent chamber having only inflow, wherein the solvent chamber is at zero pressure. Although the Examiner references Figure 11, it is actually the description of Figure 9 that is relevant. In particular, Loeb in column 12, lines 15-20, states: "Figure 9 illustrates the PRO section 102 (of Figure 8) of the heat engine; Figs. 10-14 (described below) illustrate different arrangements which may be used for the thermal unmixing section 104 (of Figure 8)." Thus, the descriptions at issue are those for Figs. 8 and 9 and not Figure. 11.

However, as pointed out above, Figs. 8, 9, and 11 of Loeb are only block diagrams and not an actual representation of the system since there is no teaching of providing sealed chambers as in Appellant's claims anywhere in Loeb.

In addition, Loeb fails to teach the creation of a vacuum in the solvent container, which as pointed out above is not taught to be a closed system. Only a closed container that did not have fluid flowing into it to replace any fluid flowing out of the container could generate a vacuum inside. As pointed out above, there is no teaching in Loeb that the solvent container is closed and therefore it cannot have a vacuum created therein as in the claimed invention.

The Figure 9 description in Loeb begins on column 12, line 15 and “[i]llustrates the PRO section 102 (of Figure 8) of the heat engine; Figs. 10-14 (described below) illustrate different arrangements which may be used for the thermal unmixing section 104 (of Figure 8).”

In particular, Loeb teaches in column 12, lines 23-57:

A concentrated solution, by which is meant one having a high osmotic pressure (π_{high}), and having a volume of V cubic meters (m^3) is pressurized by pump 122 to a hydraulic pressure P atmospheres (atm) requiring a work input of PV cubic meter atmospheres ($\text{m}^3 \text{ atm}$), after which it is pumped via line 127 into the high pressure side of the membrane unit 124. Simultaneously a diluted solution, by which is meant one having a low osmotic pressure, (π_{low}), and having a volume of $\Delta V \text{ m}^3$ is pumped (by a pump not shown) via line 128 into the low hydraulic pressure side of the membrane unit 124. The diluted solution permeates through the membranes against the hydraulic pressure P because it is arranged that everywhere in the unit $P > \Delta P$ where ΔP is the osmotic pressure difference (atm) between the solutions on each side of the membrane. This is the fundamental principle of pressure-retarded osmosis, as described above.

A volume $(V + \Delta V) \text{ m}^3$ of mixed solution is sent to hydroturbine 126 at the pressure P atm. Thus the hydroturbine delivers $P (V + \Delta V) \text{ m}^3 \text{ atm}$ of work (via connection 129) in the course of reducing the pressure of the mixed solution of zero. The net output of work is equal to the difference between the output from the hydroturbine and the input to the pump, i.e., the net work is $(P \Delta V)(\text{m}^3 \text{ atm})$.

It is important to understand that net work is obtained only from ΔV the volume of permeant liquid passing through the membranes. In order to minimize the size of the membrane unit it may be stated as a first guideline:

Guideline 1: the ratio should be maximized of net work delivered to volume of liquid passed through the membranes.

It is clear from this description that in Loeb, the diluted solute fluid is continuously flowing through the system in order to continuously turn the hydro-turbine 17. It is also clear that the additional volume added to the solute solution provided by the continuously flowing solvent solution that passes through the semipermeable barrier into the solute solution provides the additional energy needed to produce useful work. (Underlining added.)

In contrast to Loeb, the claimed invention does not rely upon additional volume of the solvent being added to the solute solution to provide the energy to operate the system.

As pointed out in paragraph 13 of the Declaration of Irving DeVoe provided herewith in the Evidence Appendix as Exhibit A:

In my system, one liter of solvent solution may transfer across the semipermeable membrane leaving a one-liter space within the solvent chamber. However, unlike the prior art, my system does not add energy to the system through an increase of volume of solvent solution flowing into the solute solution. Rather my system adds energy to the system by the solvent solution flowing into the solute chamber and substantially increasing the pressure within the chamber. For each stroke of the member only a small volume of solute solution, typically set approximately between 1 ml (radial 3 piston engine) and 20 ml (single piston engine), depending on the engine, is removed from the solvent chamber, but this small volume has a very high pressure, typically the pressure is approximately between 500 psi (3447 kPa) and 1900 psi (13100 kPa). Thus, for each stroke of the member, only a volume of approximately 1 mL to 7 mL of solvent must be vaporized within the recycling system. There is no need to vaporize the entire one-liter of solvent, for example, that has flowed into the solute chamber on a single stroke of the member. Thus, the Examiner is incorrect in his assertion that my system must vaporize the entire volume of solvent that flows through the semipermeable membrane in a single stroke of the member. (Emphasis added)

In particular, the claimed invention calls for: “periodically removing and using the increased pressure to drive a member which produces a movement from which work can be extracted.” It is the high pressure of the removed portion of the diluted solute solution that is used to drive the member to produce work.

In contrast to the claimed invention, Loeb uses substantially all of the fluid moving in pathway 124 across the membrane in pressure unit 124 and mixing with the pressurized concentrated solution in pathway 127 to ultimately turn hydroturbine 126. Thus, Loeb does not teach removing the increased pressure to do work as claimed in the claimed invention. Rather, Loeb teaches using all of the volume of fluid present, in stark contrast to the claimed invention.

In addition, unlike the claimed invention, Loeb teaches a continuously operating system, that is, fluid is constantly and continuously flowing through the Loeb system in order to provide continuous power to the hydroturbine so that the hydroturbine continuously operates and provides continuous energy. The claimed invention is one in which increased pressure is periodically applied and removed from the second chamber. Thus, in the invention, power is provided and the movement of the member occurs in discrete pulses, i.e., periodically, rather than continuously provided due to the constant flow of fluid through the Loeb system. (Underlining added).

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987); MPEP 2131. Because the above claimed method steps are lacking in Loeb, Appellant respectfully contends that an anticipation rejection under 35 U.S.C. §102 rejection of the claims is inappropriate. Appellant respectfully states that for the reasons stated above, independent claims 42 and 50 are patentably defined over Loeb. Claims 47-48, and claim 68 depend from claim 42 and are patentable for at least the same reasons. Claims 51-52 and 71 depend from claim 50 and are patentable for at least the same reasons. Thus, none of the claims are anticipated by Loeb for the reasons stated above and all claims are therefore patentable over the Loeb reference.

With respect to the 35 U.S.C. §103(a) rejection, "To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations." (MPEP 2143)

It is pointed out to the BPAI that the Examiner has not addressed in the Final Rejection how he intends to make up for the deficiencies brought up by Appellant in his rebuttal of the 35 U.S.C. §102 rejection in his support of a 35 U.S.C. §103 rejection of the claims. The Examiner has only applied Loeb under 35 U.S.C. §103 in his rejection of the claims, and clearly Loeb as pointed out above has many deficiencies when used as prior art against the present method claims. In any case, Appellant provides below even further reasons why a 35 U.S.C. §103 of the claims is inappropriate.

Based upon and as clearly shown in the above arguments, the use of the Loeb reference under 35 U.S.C. §103 would also be inappropriate. For example, the modification of the Loeb reference from a continuous system into the claimed invention, i.e., a periodic system, will render the Loeb system inoperable for its intended purposes. The Loeb system is based on continuously adding additional solvent volume via the semipermeable membrane into the solute.

Further, the Examiner states that "periodically applying can mean anything from occasional start and stop to a reciprocating system, and such schemes of energy conversion are within the capability of one of ordinary skill in the art to design." This is an incorrect statement

since nowhere in Loeb does Loeb speak of a periodic application or removal of pressure. In fact, on the contrary, Loeb uses a continuous flow of solvent and solute and relies on an increase in volume rather than, as Appellant claims, "periodically applying and removing the increased pressure to drive a member which produces a movement from which work can be extracted" (independent claim 42) or "... substantial linear displacement of the object" (independent claim 50).

It is important to note that the term "periodically" is not used in the Loeb patent. The Loeb system is described as a continuous system in the brief description of the drawings for Figs. 3 and 4, see Loeb, col. 3, lines 19-26. The Loeb patent also uses the term continuous in the description accompanying Figs. 2a and 2b, see Loeb col. 4, lines 45-53. In addition, the Loeb patent describes the process as continuous in the description of Figs. 3 and 3a, see Loeb, col. 4, lines 56-60.

In order to further clarify why Loeb (and the DE reference) does not periodically apply and remove pressure, Appellant refers the BPAI to the figures of Loeb. In particular, the pressure retarded osmosis system of Loeb is described in greatest detail with respect to Figs. 1, 2a, 2b, 3, 3a, 4, 4a, 5, and 6. In particular, each of these Figs. indicates that an external hydraulic pressure P is applied to the surface of the sea water 6 via a pump 16, 26, 66, or 36. This pressure is used to slow the flux of the permeant, fresh water, into the sea water, see Loeb, Eqs 1 and 2. This is necessary in Loeb, (and the DE reference), to allow the increased volume, ΔV to be used to provide the additional energy to drive the turbine 17, 27, 67, and 37, 47, and 57. Clearly, the pressure retarded osmosis system of Loeb (and the DE reference) of using continuous flow is different than Appellant's claimed invention and methodology.

Loeb's patent of using continuous flow in a pressure retarded osmosis system is in stark contrast to Appellant's claimed invention of "providing a sealed, first chamber; providing a sealed second chamber;...periodically applying and removing the increased pressure..." This distinction between the large volume of Loeb and the DE reference is important. For example in Loeb "A volume $(V+\Delta V)$ m³ of mixed solution is sent to the hydroturbine 126 at the pressure P_{atm} . Thus the hydroturbine delivers $P(V+\Delta V)$ m³ of work (via the connection 129) in the course of reducing the pressure of the mixed solution of zero. The new output of work is equal to the difference between the output from the hydroturbine and the input to the pump, i.e., the net

work is $(\Delta V) m^3 \text{ atm}$. It is important to understand that net work is obtained only from ΔV , the volume of permeant liquid passing through the membranes.” See Loeb, col. 12, lines 41-54.

Another distinction between Appellant’s claimed invention and the Loeb (and the DE) reference resides in Appellant providing a pair of sealed containers which cause the (osmotic) pressure to increase as the solvent passes through the membrane. Appellants claimed invention produces useable energy output when pressure is periodically applied and removed from the pressure chamber as claimed. These steps along with the step of “utilizing the semi-permeable barrier to restrict solute flow ...such that a vacuum develops in the first chamber” are not only clearly lacking in Loeb (and the DE) reference, but also not shown by the Examiner to be an obvious modification of Loeb. A change such as this in Loeb runs contrary to the intended operation of Loeb.

Appellant contends that any alteration of the Loeb patent, as in a 35 U.S.C. §103 rejection, in an attempt to meet Appellant’s claimed invention of periodically applying and removing pressure and/or providing sealed chambers, creating a vacuum in the first chamber would render the operation of Loeb (and the DE reference) contrary to Loeb’s intended purpose since Loeb relies on volume and continuous flow. Even if the Examiner found a reference(s), which he did not, which taught the deficiencies of Loeb, such a combination would be inappropriate under 35 U.S.C. §103 since “If when combined, the references “would produce a seemingly inoperative device,” then they teach away from their combination. *In re Spinnoble*, 56 C.C.P.A. 823, 405 F.2d 578, 587, 160 U.S.P.Q. (BNA) 237, 244 (CCPA 1969); see also *In re Gordon*, 733 F.2d 900, 902, 221 U.S.P.Q. (BNA) 1125, 1127 (Fed. Cir. 1984) (finding no suggestion to modify a prior art device where the modification would render the device inoperable for its intended purpose)” (as cited in *Tec-Air Inc. v. Denso Manufacturing*, 192 F.3d 1353, 1360 (Fed. Cir. 1999).) In *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740 (2007), the Court identified “teaching away” as a strong indicator of nonobviousness. The teachings of Loeb teach away from Appellant’s claimed limitations as noted above and a prima facie case of obviousness of the Appellant’s invention has not been established.

Even if the Examiner applied Official Notice to meet the deficiencies of Loeb, which he did not, based on MPEP 2144.03:

Official notice without documentary evidence to support an examiner’s conclusion is permissible only in some circumstances. While “official notice” may be relied on, these circumstances should be rare when an application is under final rejection

or action under 37 CFR 1.113. Official notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known. As noted by the court in *In re Ahlert*, 424 F.2d 1088, 1091, 165 USPQ 418, 420 (CCPA 1970), the notice of facts beyond the record which may be taken by the examiner must be "capable of such instant and unquestionable demonstration as to defy dispute" (citing *In re Knapp Monarch Co.*, 296 F.2d 230, 132 USPQ 6 (CCPA 1961))....

It would not be appropriate for the examiner to take official notice of facts without citing a prior art reference where the facts asserted to be well known are not capable of instant and unquestionable demonstration as being well-known. For example, assertions of technical facts in the areas of esoteric technology or specific knowledge of the prior art must always be supported by citation to some reference work recognized as standard in the pertinent art. *In re Ahlert*, 424 F.2d at 1091, 165 USPQ at 420-21....

Any rejection based on assertions that a fact is well-known or is common knowledge in the art without documentary evidence to support the examiner's conclusion should be judiciously applied. Furthermore, as noted by the court in *Ahlert*, any facts so noticed should be of notorious character and serve only to "fill in the gaps" in an insubstantial manner which might exist in the evidentiary showing made by the examiner to support a particular ground for rejection. It is never appropriate to rely solely on common knowledge in the art without evidentiary support in the record as the principal evidence upon which a rejection was based. See *Zurko*, 258 F.3d at 1386, 59 USPQ2d at 1697; *Ahlert*, 424 F.2d at 1092, 165 USPQ 421.

Appellant respectfully states that for the reasons stated above, independent claims 42 and 50 are patentably defined over Loeb both under 35 U.S.C. §§102 and 103. Claims 47-48, and claim 68 depend from claim 42 and are patentable for at least the same reasons. Claims 51-52 and 71 depend from claim 50 and are patentable for at least the same reasons. Thus, none of the claims are obvious over Loeb for the reasons stated above and all claims are therefore patentable over the Loeb reference.

Further comments are provided below in Sections III and IV by Appellants in response to the Examiner's Sections in the Final Rejection entitled "Response to the Declaration by Dr. McGimpsey" and "Response to Arguments." These comments by Appellant have been separated from Sections I and II since the Examiner has combined these arguments with respect to both the Loeb and DE references together.

II. Claims 42, 47-48, 50-52, 68, and 71 were rejected under 35 U.S.C. §102(b), as being anticipated by, or, in the alternative, under 35 U.S.C. §103(a), as being unpatentable over the German Patent No. DE 3121968 ("DE" or "the DE reference")

Claims 42, 47-48, 50-52, 68, and 71 were rejected under 35 U.S.C. §102(b), as being anticipated by, or, in the alternative, under 35 U.S.C. §103(a), as being unpatentable over the German Patent No. DE 3121968 ("DE" or "the DE reference") for which an English translation was provided in the record by the Examiner and it is this English translation of the DE reference, which is referred to herein by the Examiner and Appellant.

It is respectfully pointed out to the BPAI that since both the Loeb and DE references are quite similar and both rely upon a pressure retarded osmosis system (PRO), Appellant, in his attempt to reduce redundancy, incorporates within the below remarks relating to DE, the substance of the remarks as applied above to Loeb which also apply to DE.

Appellant respectfully contends that the comments below (especially in view of the similar comments with respect to Loeb) provide sufficient reasons to support that claims 42 (independent), 47, 48, 50 (independent), 51, 52, 68 and 71 are patentable over the DE reference and the Examiner's 35 U.S.C. §§102 and 103 rejections are in error.

More specifically, as set forth below, DE fails to show or describe the following, but not limited to, method steps of producing energy (independent claim 42) and of producing linear displacement of an object (independent claim 50). The DE reference fails to show steps lacking in Loeb as well as "transferring...solute solution to a third chamber" as set forth below:

- 1) providing a sealed first chamber;
- 2) providing a sealed second chamber;
- 3) utilizing the semi-permeable barrier to restrict solute from flowing into the first chamber while allowing the solvent to flow into the second chamber as the solvent flows from the first chamber into the second chamber a void is created in the first chamber such that a vacuum develops in the first chamber and increases the pressure in the second chamber;
- 4) periodically applying and removing the increased pressure to drive a member (which produces a substantial linear displacement of an object-as in claim 50); and
- 5) removing a portion of the solute solution from the second chamber and transferring the removed portion of the solute solution to a third chamber.

By not describing, disclosing or showing the above steps, DE clearly cannot be utilized to support a 35 U.S.C. §102 rejection; and without any teaching (no secondary reference utilized by the Examiner) or indication of how official notice can be taken to meet these limitations without destroying the intended operation of DE, DE cannot be utilized by the Examiner in a 35 U.S.C. §103 rejection of the claims.

In support of Appellant's position, and particularly in rebuttal of the Examiner's allegations in the Final Rejection of the claims, Appellant presents the following:

The Examiner asserts that:

DE teaches a method of pressurizing a solute solution and converting the pressure to energy (by a turbine or by a reciprocating machine, which is a piston machine: see claim 22, page 8 and [claim] 28, page 9 of the English translation of the reference; piston in the reciprocating machine has linear displacement) using a solvent by passing the solvent across into the solution through a semipermeable membrane – see Figs. The solution is exhausted after the pressure is converted to energy as claimed. Solvent chamber pressure reduces due to loss of solvent by osmosis, which would inherently create a loss of pressure, or vacuum, as discussed above. In the Figs., for example, figure 1, solvent chamber is (5), solution chamber is (6), and the membrane is (4).

DE teaches solvent recycle; and the process of evaporation can be optimally selected from the various available methods - see page 16-20 of the English translation (especially, page 18) - including air circulation, heat pump, and solar energy. Using vacuum for evaporation, particularly at ambient temperature, is known in the art. Even though the reference does not explicitly teach a third chamber, it is implied in terms of evaporation ponds or evaporators and condensers required in the various recycling schemes contemplated by the reference, which include both solvent and concentrated solute solution. (Underlining added)

“Periodically applying and removing the increased pressure” to drive a member to produce work can mean anything from occasional start and stop of a system to a reciprocation system. The reference teaches both turbine and reciprocation engines for energy conversion. Actual details to how to set up the system would be within the skill [skill] level of one of ordinary skill in the art. The claimed invention does not provide details that would make the claim patentable over the prior arts.

(See pages 3-4 of the Examiner's Final Rejection dated December 15, 2008)

It is apparent that the DE reference functions in a substantially similar way to the inappropriate Loeb reference. In particular, the DE reference, like Loeb, also uses two

continuously flowing fluids that are adjacent to one another and separated by a semi-permeable membrane. As the two fluids are adjacent to the semi-permeable membrane, the solvent will flow across the membrane into the solute, wherein the solute is used to provide energy. Accordingly, the DE reference also suffers from the same deficiencies outlined above with respect to the Loeb reference and the arguments with respect to the Loeb reference are incorporated herein by reference against the DE reference.

As pointed out above, the claimed invention calls for periodically applying and removing the increased pressure to drive a member as in claim 42 and which produces a substantial linear displacement of an object as in claim 50. This process is neither disclosed, shown, taught nor suggested in the DE reference.

In order to further clarify why the DE reference does not periodically apply and remove pressure, Appellant refers the BPAI to Figs. 1-5 of the DE reference. In particular, although not specifically labeled as a pressure retarded osmosis (PRO) system, the fact is that the DE reference is such a system and applies an external hydraulic pressure to the sea water as does Loeb. Thus, the DE reference and Loeb operate in very similar manners. In particular, each of the figures of the DE reference indicates that an external hydraulic pressure P is applied to the surface of the sea water via a pump. This pressure is used to slow the flux of the permeant, fresh water into the sea water. This is necessary in the DE reference, to allow the increased volume, ΔV to be used to provide the additional energy to drive the turbine. The only mention in the DE reference of a reciprocating machine such as a piston is in two dependent claims with no further explanation in the specification as described in the English translated DE reference as to how to effect such reciprocating action. (Underlining added). It is Appellant's contention that such reciprocation in the DE reference without a further explanation of periodically applying and removing the increased pressure as claimed does not meet the periodic application and removal of increased pressure as claimed by Appellant. Nowhere in the DE reference is such a step of periodically applying and removing of pressure described.

With respect to the Examiner's comments related to "Periodically can mean anything..." this is an incorrect statement since nowhere in the DE reference does it speak of a periodic application of pressure. In fact, on the contrary the DE reference uses a continuous flow of solvent and solute and relies on an increase in volume such as in Loeb rather than, as Appellant

describes in the specification and claims, “periodically applying and removing the increased pressure.”

As with Loeb, it is important to note that the term “periodically” is not used in the DE reference. Throughout the DE reference, the description refers to a liquid with a higher concentration that flows through one of the partial chambers and a liquid with a lower concentration flows through the other partial chamber. See English translation, pages 2 and 3. The figures and description of the DE reference show that both the high concentration and low concentration fluids have inlets and outlets to allow the continuous flow of both the high concentration and low concentration past one another. As in the Loeb reference discussed above, the DE reference provides work via the increase in volume of the fluid in a continuous manner. This is in stark contrast to Appellant’s claimed invention of “providing a sealed first chamber;” “providing a sealed second chamber” and “periodically applying and removing the increased pressure....”(Underlining added).

The same distinction exists in the DE reference as in Loeb. See DE reference (English translation), page 22. It is important to understand that net work is obtained only from ΔV , the volume of permeant liquid passing through the membranes. See the mathematical description provided in the DE reference (English translation), pages 22-31, in which it is clear that the increase in energy is due to the increase in the amount and quantity Q_r .

Appellant sets forth in the claims providing a sealed first chamber and a sealed second chamber. Providing sealed chambers are contrary to a continuous system as in the DE reference. The sealed chambers also allow for the “void to be created in the first chamber such that a vacuum develops in the first chamber and increases the pressure in the second chamber.” The method of the claimed invention permits the osmotic pressure to increase as the solvent passes through the membrane. Appellant’s claimed invention produces useable energy output when pressure is periodically applied and removed from the pressure chamber. These steps are clearly lacking in the DE reference. (Underlining added).

It is also important to note that the figures in DE are described as being block diagrams, and cannot therefore be thought of as physically representative of the detailed system without further explanation. A block diagram cannot alone be relied upon to show a closed system or an open system. Given that there is no mention of a vacuum or reduced or lower pressure in the PRO system of the DE reference, it is not logical to assume that any vacuum is produced.

Further, as with the Loeb patent, as pointed out in paragraph 13 of the Declaration of Irving DeVoe provided in the Evidence Appendix as Exhibit A, major differences exist between the references and the claimed invention:

In my system, one liter of solvent solution may transfer across the semipermeable membrane leaving a one-liter space within the solvent chamber. However, unlike the prior art, my system does not add energy to the system through an increase of volume of solvent solution flowing into the solute solution. Rather my system adds energy to the system by the solvent solution flowing into the solute chamber and substantially increasing the pressure within the chamber. For each stroke of the member only a small volume of solute solution, typically set approximately between 1 ml (radial 3 piston engine) and 20 ml (single piston engine), depending on the engine, is removed from the solvent chamber, but this small volume has a very high pressure, typically the pressure is approximately between 500 psi (3447 kPa) and 1900 psi (13100 kPa). Thus, for each stroke of the member, only a volume of approximately 1 mL to 7 mL of solvent must be vaporized within the recycling system. There is no need to vaporize the entire one-liter of solvent, for example, that has flowed into the solute chamber on a single stroke of the member. Thus, the Examiner is incorrect in his assertion that my system must vaporize the entire volume of solvent that flows through the semipermeable membrane in a single stroke of the member. (Emphasis added.)

Reference is made to the English translation of the DE reference, wherein it is described that DE teaches only that the reaction chamber (3) [note that the figures of DE mislabeled the reaction vessel as 13] has fresh water pumped into the chamber by pump 22 via line 16 and allowed to leave by line 17 (see page 2 and Figure 1). Note that there are no valves depicted so that the flow is not interrupted and is continuous. Also note that there are no pumps in the fresh water line as well so that the fresh water is at substantially zero hydraulic pressure. In the description in the specification of the DE reference, the solute and solvent solutions are taught to flow past one another through the reaction chamber 3. There is no mention of sealing the solvent side of the reaction chamber 3 or of periodically removing a portion of the increased pressure in the reaction vessel as in the claimed invention. None of the figures or descriptions teach the use of a sealed solvent chamber that is initially closed and is periodically opened as in the claimed invention.

In addition, the Appellant disputes the Examiner's assertion that "[e]ven though the reference does not explicitly teach a third chamber" (as in the claimed invention) "it is implied in terms of evaporation ponds or evaporators and condensers required in the various recycling schemes contemplated by the reference." The use of evaporation ponds does not imply a third

chamber as in the claimed invention method step and the Examiner has provided no further explanation to support this assertion.

Accordingly, claims 42 and 50 include method steps that are not disclosed, shown, nor taught by the DE reference and therefore are not anticipated by the DE reference under 35 U.S.C. §102(b). "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987); MPEP 2131. Claims 47, 48, and claim 68 depend from claim 42 and are patentable for at least the same reasons. Claims 51-52 and 71 depend from claim 50 and are patentable for at least the same reasons. Thus, none of the claims are anticipated by the DE reference for the reasons stated above and all claims are therefore patentable over the DE reference.

With respect to the 35 U.S.C. §103(a) rejection, "To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations." (MPEP 2143)

It is pointed out to the BPAI that the Examiner has not addressed in the Final Rejection how he intends to make up for the deficiencies brought up by Appellant in his rebuttal of the 35 U.S.C. §102 rejection in support of a 35 U.S.C. §103 rejection of the claims. The Examiner has only applied the DE rejection under 35 U.S.C. §103 in his rejection of the claims, and clearly DE as pointed out above has many deficiencies including those as pointed out with Loeb, and in addition, lacks a third chamber (by the Examiner's own admission) when used as prior art against the present method claims. In any case, Appellant provides below even further reasons why a 35 U.S.C. §103 of the claims is inappropriate.

Because the operation of the DE reference is based on the continuous flow of fresh water, at essentially zero hydraulic pressure, through side 5 of the reaction vessel 3, the step of providing a closed (sealed) solvent side of the reaction chamber of the type claimed would prevent the continuous flow of water as taught by the DE reference. In addition, in the various figures in the DE reference there is no storage tank or other method of regulating or storing the fresh water flowing in the system. Because there is no teaching as to storage of the fresh water in

a chamber as a substitute for the continuously pumped fresh water, it is clear to one of skill in the art that continuously pumping water into a closed (sealed) chamber, as claimed in the invention would change the operation of the DE reference by providing fresh water at higher than zero hydraulic pressure at the semi-permeable barrier between chambers 5 and 6 in the DE reference. Because the DE reference is also a pressure retarded osmosis (PRO) system, as is Loeb, this increase in the fresh water pressure would reduce the retarding pressure and change the operational characteristics of the DE reference, causing the device taught by the DE reference to produce substantially less power and even rendering the DE reference inoperable. Thus, there would be no motivation to modify the DE reference by providing a sealed first (solvent) chamber as claimed in independent claims 42 and 50, let alone add the many deficiencies to the DE reference as claimed by Appellant and set forth in detail above.

It would not be obvious to modify the DE reference to form the claimed invention because the DE reference would become inoperable for its intended purpose. The DE reference fails to discuss the use of a third chamber at all for any purpose much less recycling. In addition, the DE reference fails to discuss the use of adding energy to the used solute solution to recycle the solute solution. As discussed above, the further dilution of the solute discharged via line 9 and the solvent solution discharged via line 17 would require a great deal more energy to be added to the system. Thus, to provide a recycling system to the highly diluted solute solution is contrary to the DE reference. Modifying the DE reference to include a third chamber for recycling purposes is inappropriate and such a change is clearly unobvious under 35 U.S.C. §103.

Further, the Examiner states that "Periodically applying and removing the increased pressure to drive a member to produce work can mean anything from occasional start and stop of a system to a reciprocating system." This is an incorrect statement since nowhere in the DE reference does it speak of a periodic application and removal of pressure. In fact, on the contrary, the DE reference uses a continuous flow of solvent and solute and relies on an increase in volume rather than as Appellant claims "periodically applying and removing the increased pressure."

Appellant contends that any alteration of the DE reference, as in a 35 U.S.C. §103 rejection, in an attempt to meet Appellant's claimed method steps of providing a sealed first chamber, providing a sealed second chamber, utilizing the semi-permeable barrier to restrict solute from flowing into the first chamber while allowing the solvent to flow into the second

chamber as the solvent flows from the first chamber into the second chamber a void is created in the first chamber such that a vacuum develops in the first chamber and increases the pressure in the second chamber, periodically applying and removing the increased pressure to drive a member (which produces a substantial linear displacement of an object-as in claim 50), and/or removing a portion of the solute solution from the second chamber and transferring the removed portion of the solute solution to a third chamber would be inappropriate since these steps run contrary to the continuous, PRO system of the DE reference.

Even if the Examiner applied Official Notice to meet the deficiencies of DE reference, which he did not, based on MPEP 2144.03:

Official notice without documentary evidence to support an Examiner's conclusion is permissible only in some circumstances. While "official notice" may be relied on, these circumstances should be rare when an application is under final rejection or action under 37 C.F.R. §1.113. Official notice unsupported by documentary evidence should only be taken by the Examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known. As noted by the court in *In re Ahlert*, 424 F.2d 1088, 1091, 165 USPQ 418, 420 (CCPA 1970), the notice of facts beyond the record which may be taken by the examiner must be "capable of such instant and unquestionable demonstration as to defy dispute" (citing *In re Knapp Monarch Co.*, 296 F.2d 230, 132 USPQ 6 (CCPA 1961))....

It would not be appropriate for the Examiner to take official notice of facts without citing a prior art reference where the facts asserted to be well known are not capable of instant and unquestionable demonstration as being well-known. For example, assertions of technical facts in the areas of esoteric technology or specific knowledge of the prior art must always be supported by citation to some reference work recognized as standard in the pertinent art. *In re Ahlert*, 424 F.2d at 1091, 165 USPQ at 420-21....

Any rejection based on assertions that a fact is well-known or is common knowledge in the art without documentary evidence to support the examiner's conclusion should be judiciously applied. Furthermore, as noted by the court in *Ahlert*, any facts so noticed should be of notorious character and serve only to "fill in the gaps" in an insubstantial manner which might exist in the evidentiary showing made by the examiner to support a particular ground for rejection. It is never appropriate to rely solely on common knowledge in the art without evidentiary support in the record as the principal evidence upon which a rejection was based. See *Zurko*, 258 F.3d at 1386, 59 USPQ2d at 1697; *Ahlert*, 424 F.2d at 1092, 165 USPQ 421."

Even if the Examiner found a reference which taught these deficiencies of the DE reference, such a combination would be inappropriate under 35 U.S.C. §103 since "If when

combined, the references “would produce a seemingly inoperative device,” then they teach away from their combination. *In re Spinnoble*, 56 C.C.P.A. 823, 405 F.2d 578, 587, 160 U.S.P.Q. (BNA) 237, 244 (CCPA 1969); see also *In re Gordon*, 733 F.2d 900, 902, 221 U.S.P.Q. (BNA) 1125, 1127 (Fed. Cir. 1984) (finding no suggestion to modify a prior art device where the modification would render the device inoperable for its intended purpose)” (as cited in *Tec-Air Inc. v. Denso Manufacturing*, 192 F.3d 1353, 1360 (Fed. Cir. 1999).) In *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740 (2007), the Court identified “teaching away” as a strong indicator of nonobviousness. The teachings of the DE reference teach away from Appellant’s claimed limitations as noted above and a prima facie case of obviousness of the Appellant’s invention has not been established.

Appellant respectfully states that for the reasons stated above, independent claims 42 and 50 are patentably defined over the DE reference. Claims 47-48, and claim 68 depend from claim 42 and are patentable for at least the same reasons. Claims 51-52 and 71 depend from claim 50 and are patentable for at least the same reasons. Thus, none of the claims are obvious over the DE reference for the reasons stated above and all claims are therefore patentable over the DE reference.

Further comments are provided below in Sections III and IV by Appellants in response to the Examiner’s Sections in the Final Rejection entitled “Response to the Declaration by Dr. McGimpsey” and “Response to Arguments.” These comments by Appellant have been separated from Sections I and II since the Examiner has combined these arguments with respect to both Loeb and DE.

III. *Rebuttal to the Examiner’s Comments with Respect to the Previously Submitted Declarations*

The Examiner’s comments with respect to Dr. McGimpsey’s Declaration dated November 26, 2008 (Exhibit B), submitted to the USPTO with the Appellant’s Response dated December 1, 2008 are provided on pages 5 and 6 of the Final Office Action dated December 15, 2008. The Examiner also summarily dismissed with one sentence on page 7 of the Final Rejection the Irving DeVoe (Inventor) Declaration (Exhibit A) dated November 30, 2008 and submitted to the USPTO with the Appellant’s Response dated December 1, 2008 as being in substance the same as the McGimpsey Declaration.

Contrary to the Examiner's comments with respect to the McGimpsey Declaration that the first 21 paragraphs are moot, it should be noted that only Professor McGimpsey's comments to the July 2, 2008 Office Action are moot since the rejections dealing with 35 U.S.C. §112 have been overcome.

The first 21 paragraphs are not moot since they set forth Professor McGimpsey's extensive educational background in the field which encompasses the invention as well in paragraph 9 his familiarity with intellectual property and patentability of inventions. In addition, Professor McGimpsey is pointed out to be the holder of five patents. Paragraphs 11-14 support the fact that Professor McGimpsey has read and reviewed the present application, the Loeb and German (DE) references and the present claims. Paragraphs 15-21 deal with the claims and their support within the specification. Paragraph 22 deals with the patentability of the claims over the prior art. The Examiner's comments with respect to Professor McGimpsey's comments are rebutted below.

In the Examiner's remarks, the Examiner points out that he "sees no difference in the stated principles other than one (the references) being large and the other (Appellant's) implied as being small" (see p. 5 of the December 15, 2008 Office Action). Contrary to the Examiner's statement, the size of the system is not the issue here but rather that the references (Loeb and the DE reference) are operating in a continuous fashion, i.e., with an open system, while Appellant's invention describes and claims a system providing sealed chambers and periodically applying and removing pressure. While the Examiner is correct in pointing out the similarity between the schematic drawings of the references and Appellant's drawings, it is clear from Appellant's specification that the Appellant refers in detail to sealed or closed chambers in the specification and claims; while the references do not. That is, the specification of Appellant's invention provides structural details not provided by the schematics and the specifications of the references.

Also, the Examiner raises the point that the references teach sealed containers. However, again the sealed nature of the containers cannot be inferred from the drawings of the references as there is no description or teaching in the specifications of sealed containers in Appellant's context in either the Loeb reference or the DE reference. The references do not have any mention of sealed containers or chambers while Appellant's specification and claims clearly do as pointed out in this brief.

The Examiner further contends that work is pressure multiplied by the volume displaced. This is correct. However, this is not significant in the rejection of the claims since Appellant is not claiming patentability in the creation of work by the displacement of a piston per se. The references use continuous systems and do not make use of linear displacement as set forth in claim 50. Again the differences between the claimed invention and the references are not obvious.

The Examiner's next comments relate to osmotic pressure and hydrostatic pressure of the pump provided for in both the Loeb and the DE references. The Examiner calculates work output based on the pressure differential and volume change, but is using the hydrostatic pressure in the calculation, not the osmotic pressure. Thus, Professor McGimpsey was unable to follow the Examiner's calculations and line of reasoning. (Underlining added).

Finally, the Examiner has not established that either Loeb or the DE reference deal with periodically applying and removing the increased pressure as claimed by Appellant.

IV. Further Response to Arguments

The Examiner has missed a major point of the contribution of Loeb's pressure retarded osmosis to turbine-generated energy, which is that Loeb has increased the volume of the liquid turning the turbine from $V=1$ to $V=1.4$.

The Loeb patent is entitled "Method and Apparatus for Generating Power Utilizing Pressure-Retarded Osmosis," i.e., the higher the pressure the slower the solvent flow across the semipermeable membrane. It is not to Loeb's advantage to raise the pressure.

The objective of pressure-retarded osmosis as taught in Loeb is in the words of Loeb, himself (line 16 of the Abstract of Loeb) "forming a pressurized mixed solution of greater volume (emphasis added) than that of the first liquid introduced into the first pathway." It is the added volume, viz., ΔV of the formula $V+\Delta V$ that the pressure-retarded osmosis provides ($V+\Delta V = 1.4$).

In Figure 11 of Loeb (pump 122), the hydraulic pressure of the first liquid into pump 122 is $P=0$, viz., pressure is not enhanced over atmospheric, and as it leaves the pump the pressure is 257 atm. As the liquid leaves the Membrane Unit 124 only the volume is augmented.

After the first liquid leaves pump 122, the pressure it is at 257 atm. For Loeb to augment the pressure in the Membrane Unit 124, the rate of outflow would have to be restricted to allow greater pressure to develop, but Loeb does not retard flow. Loeb permits flow to increase.

The pressure is not augmented in the Membrane Unit 124 but the volume is.

Note that the pressure of the liquid entering the turbine is essentially the same as that out of the pump 122.

Therefore, Chamber 124 is not used as a closed, high-pressure chamber as in the present invention, but as a mixing chamber to increase the volume in the stream, i.e., to provide directly more potential energy to turn the turbine faster.

In addition, contrary to the Examiner's argument that "...any vacuum or void in the first chamber would stop the system from functioning because it will starve for solvent – for the system to work there has to be a steady supply of solvent," the invention conveys that there is a supply of solvent in the system. The solvent solution is always maintained in contact with one side of the semipermeable membrane surface. The solvent molecules in the solution are in constant motion, and a portion of them at any one time have a trajectory through the pores in the semipermeable membrane and pass into the second chamber unaffected by the vacuum above the solvent surface. The pressure in the sealed second chamber will continue to build simultaneously as the vacuum develops in the first chamber. The solvent in the first chamber is kept in constant contact with the first chamber side of the semipermeable membrane. At some time during operation of the present invention, the solvent in the chamber will begin to deplete. At this time a valve closes the first chamber that is low in solvent and another valve opens a separate chamber full of solvent that is used to replenish the solvent fluid both in terms of chemical composition and in terms of fluid as well. In this way the claimed process may continue.

In summary, in Appellant's claimed invention, through the use of sealed containers, solvent flows into a dilute solute solution and causes the generation of pressure that can be converted to useful work. The Loeb and DE references do not use sealed containers nor the periodic application and removal of pressure, and their use of open containers is inherently inefficient.

Osmotic pressure is the pressure that is generated by providing a sealed container as the result of the flow of pure solvent across a semi-permeable membrane into a solute solution. If the container is sealed, this will result in a pressure change in the chamber. Solvent will continue

to flow until the hydrostatic pressure in the sealed chamber is equal to the osmotic pressure. In effect, the solvent flows into the solution against a pressure gradient. For “equilibrium” to be reached (steady state, not a thermodynamic equilibrium) the “activity” of the pure solvent and solution must be equal and this is achieved by an imbalance in pressure between the pure solvent side of the membrane and the solution side of the membrane. It is the hydrostatic pressure created by the flow of solvent into the sealed chamber that can be “harvested” to do mechanical work.

Appellant’s claimed invention is a direct and efficient way to cause mechanical work to flow (the correct thermodynamic terminology refers to work flow), by having the flow of pure solvent into a sealed chamber and then periodically release the pressure, as in a reciprocating system, since this allows the maximum increase in pressure. Neither Loeb nor the DE reference deal with providing sealed containers, their systems are based on continuous flow.

Further, in response to arguments and in describing Loeb’s and DE’s system, the Examiner discusses the pressures produced by flow of solvent through the membrane and by the mechanical pump in pumping the solution through the chamber. Clearly, as the Examiner states, in a sealed container and at “equilibrium” the flow of pure solvent through the membrane will cause an increase in hydrostatic pressure that is equal to the osmotic pressure. Whether the osmotic pressure is 470 atm in such a system, as stated, is dependent on the concentration of solute on the solute side of the membrane.

The key point is that Loeb and the DE reference do not use sealed containers. As the Examiner points out, Loeb/DE are pumping solute solution through the solution chamber. Loeb/DE do this because the higher the solute concentration that one can maintain, the higher the hydrostatic pressure that is produced. If they did not pump the solution through the chamber, the pure solvent that passes into the solute chamber would dilute the solute, lower the concentration and reduce the hydrostatic pressure. In order to pump the solution through the chamber, thereby maintaining the gradient, the chamber cannot be sealed in Loeb/DE – it must be open. This analysis is clear from the lowered hydrostatic pressure in the solute chamber – 255 atm versus the theoretical value of 470 atm as quoted by the Examiner.

As another point, the Examiner states the work output of the system at the turbine is equal to the difference in pressures between the high pressure side of the turbine and the low pressure side of the turbine (in the example cited in Loeb, this is $255 - 7 = 248$ atm) multiplied by the flow

rate ($V+\Delta V$). The net work, however, as Loeb states in the explanation of Figure 9, is dependent only on the incremental volume caused by flow of solvent through the membrane (ΔV). The Examiner states that V is small compared to ($V+\Delta V$). In the Loeb example (Figure 11), this is clearly not the case. ΔV is smaller than V and V is therefore comparable in magnitude to $V+\Delta V$. The point is that it is necessary for Loeb (and the DE reference) to relatively rapidly replenish the high solute side of the membrane, which in turn requires considerable energy from the mechanical pump, in turn decreasing the net work produced by the system.

The Examiner refers to the vacuum in Appellant's system that results from flow of solvent across the membrane. The vacuum results from the sealed nature of the container. In a reciprocating system, as claimed, this vacuum can be used to induce solvent flow, potentially increasing the overall efficiency of the system during operation.

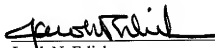
CONCLUSION

In summary, Appellant respectfully submits that claims 42, 47-48, 50-52, 68 and 71 are clearly patentable for the aforesaid reasons and thus Appellant respectfully requests this Honorable Board to reverse the decision of the Examiner.

Respectfully submitted,
Irving W. DeVoe, Appellant

Dated: August 14, 2009

By:



Jacob N. Erlich
Reg. No. 24,338
Attorney for Appellant

CLAIMS APPENDIX

1-41. (Cancelled)

42. (Previously presented) A method of producing energy, comprising:

providing a sealed first chamber;

providing a sealed second chamber;

providing a semi-permeable barrier separating the first chamber from the second chamber;

filling the first chamber with a solvent;

filling the second chamber with a solute solution comprising a solute and solvent;

providing communication between the solvent solution and solute solution to cause the solvent to flow from the first chamber through the semi-permeable barrier into the second chamber,

utilizing the semi-permeable barrier to restrict solute from flowing into the first chamber while allowing the solvent to flow into the second chamber as the solvent flows from the first chamber into the second chamber a void is created in the first chamber such that a vacuum develops in the first chamber and increases the pressure in the second chamber;

periodically applying and removing the increased pressure to drive a member which produces a movement from which work can be extracted;

removing a portion of the solute solution from the second chamber and transferring the removed portion of the solute solution into a third chamber;

applying energy to the removed portion of the solute solution in the third chamber thereby vaporizing the solvent contained in the removed portion of the solute solution and thereby separating the solute in the removed portion of the solute solution; and

recycling the separated solute to the second chamber.

43-46. (Cancelled)

47. (Previously Presented) The method of claim 42, further comprising condensing the vaporized solvent to liquid solvent.

48. (Previously Presented) The method of claim 47, further comprising returning the liquid solvent to the first chamber.

49. (Cancelled)

50. (Previously presented) A method for producing a linear displacement of an object, comprising:

- providing a sealed first chamber;

- providing a sealed second chamber;

- providing a semi-permeable barrier separating the first chamber from the second chamber;

- filling the first chamber with a solvent;

- filling the second chamber with a solute solution;

- providing communication between the solvent and the solute solution to cause the solvent to flow from the first chamber through the semi-permeable barrier into the second chamber;

- utilizing the semi-permeable barrier to restrict the solute from entering the first chamber while allowing solvent molecules to flow into the second chamber as the solvent flows from the first chamber into the second chamber a void is created in the first chamber such that a vacuum develops in the first chamber and an increase of the pressure in the second chamber;

periodically applying and removing the increased pressure to drive a member which produces a substantial linear displacement of the object;

removing a portion of the solute solution from the second chamber and transferring the removed portion of the solute solution to a third chamber;

applying energy to the removed portion of the solute solution in the third chamber thereby vaporizing the solvent contained in the removed portion of the solute solution thereby separating the solute in the removed portion of the solute solution; and

recycling the separated solute to the second chamber .

51. (Previously Presented) The method of claim 50, further comprising pressurizing the first chamber.

52. (Previously Presented) The method of claim 51, wherein pressurizing the solvent chamber comprises using an external pressure pump in communication with the first chamber.

53-67. (Cancelled)

68. (Previously Presented) The method of claim 42, wherein the application of energy heats the solute solution to separate solute molecules from solvent molecules.

69-70. (Cancelled)

71. (Previously Presented) The method of claim 50, wherein the application of energy heats the solute solution to separate solute molecules from solvent molecules.

EVIDENCE APPENDIX

The Declarations under 37 C.F.R 1.132 of Irving DeVoc, Ph.D. (attached hereto Exhibit A) and William Grant McGimpsey, Ph.D. (attached hereto as Exhibit B) were submitted by Appellants in their Response/Amendment dated December 1, 2008.

Exhibit A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Irving DeVoe.

Confirm. No.: 9677

Application Serial No.: 10/626,209

Group Art Unit: 1797

Filed: July 24, 2003

Examiner: Krishnan Menon

Docket Number: (Now 41613-101)

Title: SYSTEM AND METHOD FOR CONVERTING KINETIC ENERGY
OF GASES OR LIQUIDS TO USEFUL ENERGY, FORCE AND WORK

DECLARATION UNDER 37 CFR 1.132

I, Irving DeVoe, Ph.D. declare and state that:

1. I, Irving W. DeVoe, am the sole inventor of the above referenced patent application that is published as Patent Application No. 2005/0016924 A1 on January 25, 2005, naming Irving DeVoe as the sole inventor, and being entitled "System and Method for Converting the Kinetic Energy of Gases or Liquids to Useful Energy, Force, or Work". I have reviewed the above referenced patent application prior to filing and again prior to making this declaration and I have also reviewed the currently pending claims and the most recent Office Action therein, dated July 2, 2008.

2. I am currently employed by Effusion Dynamics, LLC. A more complete CV is attached hereto as Attachment A

3. I received my B.Sc. in Chemistry from Aurora College, Aurora Illinois, in 1964.

4. I received my Ph.D. in 1968 from University of Oregon Medical School, Portland, Oregon in 1968.

5. Postdoctoral Fellow, Macdonald College of McGill University, Montreal, Canada. 1968 -1969.

6. I have worked on intellectual property issues during the course of my career and I am familiar with evaluating intellectual property with respect to potential patentability.

7. I am a named inventor on 6 issued US Patents.

DeVoe, Irving W. Apparatus for continuous removal of materials from a liquid . 1992 US Patent # 5089123

DeVoe, Irving W. et al. Removal of contaminants and recovery of metals from waste solutions. 1992. US Patent # 5173179

DeVoe, Irving W. Removal of contaminants and recovery of metals from waste solutions 1991. US Patent # 5066371

DeVoe, Irving W. et al. Insoluble chelating compositions. 1986. US Patent #4585559

DeVoe, Irving W. et al. Insoluble chelating compositions. 1985. US Patent # 4530963

DeVoe, Irving W. Insoluble chelating compositions. 1984. US Patent # 4626416

With reference to the published application, I declare and state that:

8. I have read and reviewed the above-identified Published Patent Application No. 2005/0016924 A1, published on January 25, 2005 and, as the sole inventor listed thereon, I understand the published patent application including its specification as well as all of the figures contained therein, and the currently pending claims.

9. I have read and reviewed the above-identified Office Action dated July 2, 2008 and understand the contents thereof and factual issues raised in or by the Office Action. In addition, I have reviewed the Loeb reference (US Patent 3,906,250) and the German reference (DE 3121968).

10. The invention described and claimed in the published patent application involves a system that provides for the osmotic fluid flow from a solvent chamber into a solute chamber to generate fluidic pressure that can be used to power a mechanical device such as a piston to convert the generated fluidic pressure into mechanical energy. The application describes the conversion of molecular kinetic energy, i.e., thermal energy, in one embodiment, to the kinetic energy of a piston. It is my opinion that both the Loeb and the German references function in a continuous manner and basis and that the extra energy the system uses for mechanical power is provided by the addition of a substantial volume of solvent being continuously added to the solute. In contrast, the presently claimed invention of DeVoe relies upon an increase in pressure (not volume) provided by the addition of a relatively small amount of solvent to the solute solution as it passes

through a semipermeable membrane from the solvent container into the solute container as described in the DeVoe specification. The Loeb and German references do not rely on an increase in pressure because of the continuous flow of solvent into the solute across the semipermeable membrane in what is not a closed system. The presently claimed invention clearly recites periodically extracting a small portion of the mixed solvent and solute solution at a high pressure to provide the necessary energy.

11. The Examiner in his office action has said that the figures do not show the hermetically sealed connections between the receiving chamber, the condenser, and the solvent chamber. The figures are block diagrams and are not mechanical drawings of the system. As a scientist and one of ordinary skill in the art, I understand that to maintain a vacuum between the various components, I would need to hermetically seal the joints between the various components or air would be able to enter the system and reduce or destroy the vacuum.

12. In the office action, the Examiner asserts my invention is not logically feasible and claims that given the volume of one liter of vapor compared to one liter of water, my system cannot physically work.

13. This shows a misunderstanding of how this system works. In my system, one liter of solvent solution may transfer across the semipermeable membrane leaving a one-liter space within the solvent chamber. However, unlike the prior art, my system does not add energy to the system through an increase of volume of solvent solution flowing into the solute solution. Rather my system adds energy to the system by the solvent solution flowing into the solute chamber and substantially increasing the pressure within the chamber. For each stroke of the member only a small volume of solute solution, typically set approximately between 1 ml (radial 3 piston engine) and 20 ml (single piston engine), depending on the engine, is removed from the solvent chamber, but this small volume has a very high pressure, typically the pressure is approximately between 500 psi (3447 kPa) and 1900 psi (13100 kPa). Thus, for each stroke of the member, only a volume of approximately 1 mL to 7 mL of solvent must be vaporized within the recycling

system. There is no need to vaporize the entire one-liter of solvent, for example, that has flowed into the solute chamber on a single stroke of the member. Thus, the Examiner is incorrect in his assertion that my system must vaporize the entire volume of solvent that flows through the semipermeable membrane in a single stroke of the member.

14. I have operated my system and have measured the following values during operation:

- Pressure in the solute chamber: 2200 psi (15,168 kPa)

Volume of solute removed per stroke: 3 mL - 20 mL (Radial 3 piston engine and single piston engine, respectively).

- Frequency of the stroke: 30 cycles per minute (@ 20 mL piston displacement; single piston engine) and 200 rpm (@ 3 piston radial motor; 1 mL displacement).
- Amount of solute recycled per stroke: 10 mL and 0.6 mL, respectively).
- Amount of solvent recycled per stroke: 0.3mL (solvent recycled in radial engine only) .
- Rate of flow of volume of solvent that flows across the semipermeable membrane: 600 mL/min in larger single piston engine and 600 mL in the radial engine.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.


Irving DeVoe, Ph.D.

11/30/08
Date

ATTACHMENT A
C.V. OF IRVING DEVOE, Ph.D.

CURRICULUM VITAE

Irving W. DeVoe, Ph.D.

Married, 5 children

Address: 197 Greenhaven Rd.
Pawcatuck, CT 06379

Registries

Who's Who in America (not kept current)
Who's Who in Canada (not kept current)
American Men and Women in Science (not kept current)

Work experience:

2003– date	Chief Scientist & Manager Effusion Dynamics LLC Boston, MA
1995 – 2004	Chief Scientist and Principal MR3 Systems, Inc. San Francisco, CA
1992 – 1995	President Metanetix Technical Services, Inc. (Anaconda Copper Mine) Butte, Montana
1990 – 1992	President and Owner DeVoe Environmental Laboratory Palm Springs, CA
1988 – 1991	President, Chief Scientist, and Principal Metanetix, Inc. Camarillo, CA
1984 – 1987	Chairman and Chief Scientist DeVoe Holbein International Inc. The Hague, Netherlands

- 1978-1984 Professor and Chairman
 Department of Microbiology and Immunology
 Faculty of Medicine
 McGill University
 Montreal, Canada
- 1978 -1984 Medical Scientist: Royal Victoria Hospital
 Montreal, Canada
- 1978 – 1984 Medical Scientist, Montreal General Hospital
 Montreal, Canada
- 1970 – 1978 Associate Professor
 Department of Microbiology
 Faculty of Agriculture
 Macdonald College of McGill University
 Ste. Anne-de-Bellevue, Quebec, Canada
- 1969 – 1970 Research Associate
 Argonne National Laboratory
 U.S. Atomic Energy Commission
 Argonne, IL
- 1968 – 1969 Post-Doctoral Fellow
 National Research Council Canada,
 Macdonald College,
 McGill University, Montreal, Canada
- Research**
- 1964 - 1969 Metal requirements and interactions with organic
 molecules in the cell walls and membranes of bacteria.
- 1970 – 1984 (1) Pathogenesis of meningococcal meningitis;
 Microbial physiology and biochemistry as it relates to
 pathophysiology in the human host;
 (2) Microbial electron transport systems in *Neisseria*
meningitidis;

- (3) *In vivo* studies of meningeal pathogenesis in rabbits inoculated with *Neisseria meningitidis* in cerebral left lateral ventricle.
- (4) Electron microscopy (Scanning, transmission, freeze-etching);
- (5) Iron requirements and uptake from human transferrin by virulent and avirulent meningococci;
- (6) Blockage of step in leukotriene synthetic pathway after exposure to cell wall fragments of meningococci.

1968 Ph.D. Microbiology and Immunology
 University of Oregon Medical School
 National Institutes of Health, Pre-Doctoral Trainee
 Portland, OR

1964 B.S., Aurora College, Highest honors
 Aurora, Illinois

Military Service

1954- 1957 U.S. Army Reserve (National Guard) - Fire Direction
 Control; Graduate, U.S. Army Artillery and Guided
 Missile Officer Candidate School, Fort Sill, Oklahoma.

1957 - 1961 U.S. Navy, Carrier-based, Air Antisubmarine Squadron
 38 & 33, Magnetic Anomaly Detection, Electronic
 countermeasures; Expeditionary Forces Vietnam

Invited speaker at International Conferences and Symposia

MR3 technology: a national strategy for the environment. Cairo, Egypt.

An economic recovery of high quality, single-metal products from electric arc furnace dust and other mixed-metal wastes. TMS Fall 2002 Extraction and Processing Division. Sweden.

MR3 technology for Profitable Metal Recovery from Taiwanese Wastes. (3 seminars.) (1) government officials, (2) circuit board manufactures, and (3) metal finishers.

Hanford Reservation, U.S. Nuclear Regulatory Agency, U.S. Department of Energy, Richland, WA (2 Seminars)

Canadian Nuclear Society, International Conference, Montreal, Canada

High Affinity Radionuclide Metal Capture, Royal Society of Chemistry, England

Cleanup of Soils and Sediments, Canadian Inland Water Resources, Toronto Harbour Commission, Toronto, Ontario (2 symposia)

Natural Resource (Metals) Recovery Technology Leadership Forum, U.S. Department of Energy.

Colloquium on Infectious Diseases, Academy of Sciences, Frankfurt, Germany

Biological implications of Microbial Pathogenicity, Montreal, Canada (3 Symposia)

Epidemic Meningitis, International Congress of Microbiology, Boston, U.S.A.

Biotechnology and Business Congress, Prague, Czech Republic

And others.

Areas of Industrial Research:

Harnessing Kinetic energy (heat) from the earth's atmosphere for the production of mechanical Work and Electricity;

Economical recovery and recycle of metals from solid and liquid wastes, metals plating rinse waters, contaminated ground water, and others;

Recovery of catalytic precious metals from polyalcohols (plastic softeners wastes) waste waters,

Chemical synthesis of high-affinity metal-capture molecules for recovery of Radionuclide from solid and liquid wastes;

Separation and recovery of valuable metals from Electric Arc Furnace Dust waste (Steel);

Solubilization, separation and production of high purity metal products from scrap brass, brass stack dust, zinc skimmings, zinc fines, ore tailings, acid mine water, and others;

Cleaning industrial metals from contaminated soils;

Recovery of Gold from recalcitrant ores;

Separation of Gold and platinum metals by novel selective capture molecules;

A novel and economical means to extract gold and platinum metals from a variety of ores;

A rapid, inexpensive and novel process for the oxidation of reduced, sulfide metal ores;

Recovery and purification and recycle of Vanadium, Chromium, and Titanium from foundry slags;

Control of bacterial growth in various industrial products by means of iron limitation (selective high-affinity metal capture);

Helical device (Heavy Equipment) for the (1) Extractions of metals from ores or solid wastes; (2) the continuous separation of heavy metals from mixed metal extracts or liquid wastes; And others.

Patents: >25 patents and current patents applications worldwide:

Publications

Chapters in books:

- (1) *Krasemann, C. (Ed)*, DeVoe, I.W. 1983. A view to future studies on the pathogenicity of *Neisseria meningitidis*: beyond antibiotics.
Infektiologisches Kolloquium 1 Neues von „alten“ Erregern und neue Erreger, de Gruyter, Berlin 1983.
- (2) *Schlessinger, David (Ed)* I. W. DeVoe and J. M. Ingram.
Microbiology 1977, American Society of Microbiology, Washington, D.C.
- (3) Simonson, C. and I. W. DeVoe. 1983. The removal of iron from transferrin at the meningococcal surface. *Microbiology* 1983. American Society of Microbiology, Washington, D.C.

Articles in Scientific Journals:

DeVoe, I.W. and B.E. Holbein. 1986. A new generation of solid state metal complexing materials: models and insight derived from biological systems. Symposium I (Industrial) Annual Chemical Congress, Royal Society of Chemistry, Kent, England.

DeVoe, I.W., E. Van der Vlist and B.E. Holbein. 1985 DeVoe-Holbein technology for the extraction of hazardous waste metals. Hazardous Materials Management Conference, Hamburg, Germany.

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Exhibit B

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Irving DeVoe.

Confirm. No.: 9677

Application Serial No.: 10/626,209

Group Art Unit: 1797

Filed: July 24, 2003

Examiner: Krishnan Menon

Docket Number: 41056-101

Title: SYSTEM AND METHOD FOR CONVERTING KINETIC ENERGY
OF GASES OR LIQUIDS TO USEFUL ENERGY, FORCE AND WORK

DECLARATION UNDER 37 CFR 1.132

I, William Grant McGimpsey, Ph.D. declare and state that:

1. I have been retained and have been paid by Burns & Levinson, LLP on behalf of the Applicant (Inventor), Irving W. DeVoe, and the assignee Effusion Dynamics, Inc. to prepare this Declaration based upon my review of published Patent Application No. 2005/0016924 A1, published on January 25, 2005, naming Irving DeVoe as the sole inventor, and being entitled System and Method for Converting the Kinetic Energy of Gases or Liquids to Useful Energy, Force, or Work as well as the most recent Office Action therein, dated July 2, 2008, the current presented claims, the Loeb and German references, and my own relevant education/experience. I have no other relationship with the inventor, Irving W. DeVoe, or the assignee, Effusion Dynamics, Inc.

2. I am currently Associate Provost for Research and Graduate Studies *ad interim* at Worcester Polytechnic Institute (WPI), Director of the WPI Bioengineering Institute, a Professor of Chemistry at WPI, and the President and Co-Founder, Active Surface Technologies Inc. A more complete CV is attached hereto as Exhibit A

3. I received my B.Sc. in Chemistry from Brock University, St. Catharines, Ontario, Canada in 1978.

4. I received my M.Sc. in Chemistry from Brock University, St. Catharines, Ontario, Canada in 1981.

5. I received my Ph.D. in Physical Chemistry from Queen's University, Kingston, Ontario, Canada in 1985
6. I completed 4.5 years as a research associate at the National Research Council of Canada from 1985-1989.
7. I joined WPI in 1989 as an assistant professor of chemistry, was appointed an Associate Professor in 1994 and promoted to a full Professor in 1998.
8. I have taught Chemical Thermodynamics to engineering and science majors at WPI from 1989 to 2005. In addition, I have taught hundreds of classroom hours in thermodynamics with focus on the first and second laws, the kinetic theory of gases, equilibrium, colligative properties such as boiling point elevation and osmotic pressure, phase diagrams etc., and, consequently, feel qualified to understand the skill level of one of ordinary skill in the art of thermodynamics, osmotic pressure and energy transfer.
9. In my position as associate provost, I oversee the WPI Office of Technology Transfer and I am familiar with evaluating intellectual property with respect to potential patentability.
10. I am a named inventor on 5 issued US Patents. (7,214,538; 6,902,720; 6,893,716; 6,746,595; 6,660,526)

With reference to the published application, I declare and state that:

11. I have read and reviewed the above-identified Published Patent Application No. 2005/0016924 A1, published on January 25, 2005 and understand the published patent application including its specification and the currently presented claims as well as all of the figures contained therein.
12. I have read and reviewed the above-identified Office Action dated July 2, 2008 and the Loeb reference (US Patent 3,906,250) and the German reference (DE 3121968) cited in the office action and I understand the contents thereof and factual issues raised in or by the Office Action.

13. I have read and reviewed the Loeb and German references provided to me by Burns and Levinson that pertain to the current application.

14. I have read and reviewed the currently presented claim amendments prepared by Burns and Levinson, specifically where the claims have been labeled Currently Amended, Canceled, and Previously Presented. I state here that I agree with these amendments and further state that in my opinion they represent valuable amendments to the claims and do not materially change the concepts nor diminish the novelty of the application.

15. The invention described and claimed in the published patent application involves a system for the use of osmotic fluid flow to generate fluidic pressure that can be coupled with a mechanical device, such as a piston, to convert the generated fluidic pressure into mechanical energy. The inventor accurately ascribes the energy considerations of this device to the conversion of molecular kinetic energy, i.e., thermal energy, in one embodiment, to the kinetic energy of a piston.

16. In my opinion, it is well disclosed in the application for purposes of one of ordinary skill in the art that the system operates in three states. In an initial state there is a concentration gradient between the solvent and pressure chambers caused by the osmotic pressure generated by the movement of solvent solution across the semi-permeable membrane into the solute solution. In an intermediate state, an equilibrium has been achieved between the osmotic pressure exerted by the solvent chamber and the mechanical pressure exerted by the pressure chamber. To reach this intermediate equilibrium state, work will flow out of this system as a result of a piston moving in response to the generated fluidic pressure developed in the pressure chamber. Finally, in a third state, the system is regenerated to the initial state by the introduction of solute into the pressure chamber and solvent into the solvent chamber and by the addition of energy to the system.

17. Claim 42 as currently amended in the response provided herein describes how a system, which in its initial state includes of a solute-solvent sub-system separated from a pure solvent sub-system by a semi-permeable barrier, undergoes a change such that pure

solvent flows through the barrier from the pure solvent sub-system to the solvent-solute sub-system. This solvent flow is driven thermodynamically by the concentration gradient between the two sub-systems and continues until an equilibrium condition is reached in which the magnitude of the concentration gradient is decreased. In the process, a pressure gradient is produced due to the increase in the amount of material in the solvent-solute sub-system and the decrease in the amount of material in the pure solvent sub-system. Claim 42 correctly claims that this pressure gradient can be used to create work through the induced motion of a piston. Further, Claim 42 also correctly claims that regenerating the concentration gradient can be achieved through the removal of a portion of the solute-solvent sub-system to a separate chamber, the application of energy to evaporate a portion of the solvent from this chamber and the addition of the remaining concentrated solute to the solute-solvent sub-system. Effectively this regenerates the initial concentration gradient of the solute-solvent sub-system. Claim 42 includes a thermodynamically allowed processes, i.e., there are no thermodynamic laws violated in this claim.

18. Previously presented Claims 47 and 48 describe the recovery of solvent and its addition to the solvent sub-system, again effectively regenerating the initial state of the solvent system.

19. Claim 50 repeats Claim 42 with the addition of an embodiment in which the work that is caused to be created by the pressure gradient is manifested in the linear displacement of a piston. Claim 50 therefore likewise includes a thermodynamically allowed processes, i.e., there are no thermodynamic laws violated in this claim.

20. Claims 68 and 71 describe the application of energy to evaporate solvent from the solvent-solute mixture that is diluted by the flow of solvent through the barrier.

21. It is my opinion that, based upon my review of the published application, the currently presented claims, and the Office Action, all referred to above, that one of ordinary skill in the art

would be able to practice the invention based upon the teachings and description set forth in the specification of the application.

22. In addition, I have been asked by Attorney Thomas Grodt of Burns & Levinson, LLP as to my opinion on the patentability of the present claims over the Loeb reference (US Patent 3,906,250) and the German reference (DE 3121968). As stated above, I have read the Loeb and German references and it is my opinion that both the Loeb and the German references function in a continuous manner and basis and that the extra energy the system produces for mechanical power is provided by the addition of a substantial volume of solvent being continuously added to the solute. In contrast, the presently claimed invention of DeVoe relies upon an increase in pressure (not volume) provided by the addition of solvent to the solute solution as it passes through a semipermeable membrane from the solvent container into the solute container as described in the DeVoe specification. The Loeb and German references do not rely on an increase in pressure because of the continuous flow of solvent into the solute across the semipermeable membrane in what is not a closed system. The presently claimed invention clearly recites periodically extracting a portion of the solvent solution at the increased pressure to provide the necessary energy to drive an object and perform mechanical work. Based upon my understanding of one of ordinary skill in the art, neither the Loeb reference nor the German reference describes the claimed invention. Therefore, neither the Loeb reference nor the German reference can be used to negate the patentability of the presently claimed invention. Likewise, given the differences in the methods of operation between the presently claimed invention and the Loeb and German references, it would not be obvious to one of ordinary skill in the art to modify either the Loeb reference or the German reference as the Examiner suggests. Since the operation of the Loeb and German references are inherently different than the presently claimed invention, the presently claimed invention is clearly patentable over the Loeb and German references.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States

Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



William Grant McGimpsey, Ph.D.

November 26/08

Date

C.V. OF PROF. GRANT MCGIMPSEY, Ph.D.
(REFERRED TO IN DECLARATION AS EXHIBIT A)

William Grant McGimpsey, Ph.D.

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E-mail: wgm@wpi.edu

PROFESSIONAL SUMMARY

- ♦ Associate Provost for Research and Graduate Studies *ad interim*
- ♦ Director, WPI Bioengineering Institute
- ♦ WPI Trustees Award for Outstanding Research and Creative Scholarship
- ♦ >\$9 million funding from corporate and government sources (as PI, co-PI)
- ♦ President and Co-Founder, Active Surface Technologies Inc.

CURRENT RESPONSIBILITIES at WORCESTER POLYTECHNIC INSTITUTE

Associate Provost for Research and Graduate Studies (ad interim) (Appointed 2007):

- Enhance government and corporate sponsored research programs
- Establish and enhance collaborative research relationships with other institutions
- Manage Congressionally appropriated funds
- Oversee Office of Research Administration, Office of Research and Graduate Studies, Office of Technology Transfer

Director, WPI Bioengineering Institute (Appointed 2005)

- ♦ Establish research funding streams to create technology pipeline
- ♦ Establish multidisciplinary faculty teams to pursue funding
- ♦ Identify technologies for IP protection and out-licensing opportunities
- ♦ Establish and foster academic-corporate research partnerships
- ♦ Commercialize medical technologies by creating start-up companies

Professor of Chemistry, Worcester Polytechnic Institute (WPI), Worcester, MA (Appointed Assistant Professor 1989, Associate Professor 1994, Professor 1998)

- ♦ Research interests include: Surface chemistry; Thin Film Devices; Optical and Electrochemical Sensors; Biosensors; Nanofluidics; Photoswitchable surfaces
- ♦ Teaching interests include: Surface Chemistry; Nanoscience; Thermodynamics; Kinetics

OTHER CURRENT POSITIONS

Adjunct Research Professor, UMASS Medical School (Appointed 2004)

- ♦ Develop surface modification methods to prevent biofilm formation on surgical devices

President and Co-Founder, Active Surface Technologies Inc.

- ♦ ASTI creates novel medical and solar energy devices using its patented thin film technology.

PAST POSITIONS

Consultant, Argose Incorporated, Waltham, MA (2002-2004)

Design and synthesis of novel fluorophores as glucose sensors. (Proprietary)

Visiting Professor, University of Massachusetts Medical School, Worcester, MA (2002-2003)

Cancer Biology. Identification and characterization of centrosome protein complexes in human tumor cells. Established stable cell lines to express high endogenous levels of TAP-tagged centrosome proteins (pericentrin, kendrin). (Sabbatical. Sponsor: US Army)

Consultant, Bayer Business Group Diagnostics, Medfield, MA (2000-2003)

Lead technical consultant in development of sensors for the detection of electrolytes, urea and enzymes in blood. Designed, synthesized and confirmed viability of new ion-selective ionophores and bulk optodes.

Visiting Scientist, Max-Planck-Institut für Strahlenchemie, Mülheim, Germany (1995-1996)

Directed activities of technical personnel and carried out research on photoionization of aromatic amino acids. Work led to publication and several funded research proposals. (Sabbatical. Sponsor: Deutsche Akademische Austauschdienst)

Consultant, Aspen Systems, Marlborough, MA (1993-1995)

Sub-contractor for Phase 1 SBIR laser eye protection project. Directed graduate students in the synthesis and spectroscopic evaluation of laser eye protection materials based on multiphoton response.

Consultant, Polaroid Corporation, Cambridge, MA (1992-1994)

Directed graduate and undergraduate student research in the design and evaluation of one- and two-photon photoacid generators for photolithographic applications.

POST-DOCTORAL RESEARCH EXPERIENCE

Research Associate, National Research Council Canada, Ottawa, Canada (1987-1989), Molecular Materials Group. (Bryn Mille, Advisor)

Synthesis and EPR characterization of metal/organic materials. Developed in-situ laser ablation and magnetron sputtering techniques for evaporation and deposition of metals.

Research Associate, National Research Council Canada, Ottawa, Canada (1984-1987), Reaction Intermediates Group (J.C. (Tito) Scalano, Advisor)

Laser investigation of photochemical and photophysical processes in solution and the solid state. Two-laser, two-color photochemistry.

EDUCATION

Ph.D. (Physical Chemistry), Queen's University, Kingston, Ontario, Canada. 1985

Dissertation: An ESR study of the reactions of phosphorus and organometallic radicals with thioketones.

M.Sc. (Chemistry), Brock University, St. Catharines, Ontario, Canada. 1981

Thesis: Solute effects on the generation and decay of primary species in the flash photolysis of indole.

B.Sc. (Chemistry), Brock University, St. Catharines, Ontario, Canada. 1978

AWARDS and HONORS

- ♦ WPI Trustees Award for Outstanding Research and Creative Scholarship 2002
- ♦ Leonard P. Kinnicutt Chair in Chemistry, Worcester Polytechnic Institute. 1993-1995
- ♦ NSERC Postgraduate Fellowship. 1981-1984
- ♦ Ontario Graduate Fellowship 1979

OTHER ADMINISTRATIVE DUTIES

- ♦ Chair, President's Commission on Research and Graduate Education (2004-present)
- ♦ Member, President's Task Force (2004-2006)
- ♦ WPI Committee on Appointments and Promotions (2004 – present, currently secretary)
- ♦ Provost Search Committee (2004)
- ♦ WPI Committee on Research Misconduct (2004)
- ♦ Chair, Department Graduate Studies Committee (1995-2005)
- ♦ Secretary and Co-Chair, Committee on Tenure and Academic Freedom (1999-2002)
- ♦ Secretary and Chair, Committee on Graduate Studies and Research (1997-2000)

PUBLICATIONS and PATENTS

Book Chapters

- 1) McGimpsey, W. G. "Spectroscopy and Reactivity of Upper Excited States and Excited Reaction Intermediates" *Molecular and Supramolecular Photochemistry*, 1998, 2, 249-306.
- 2) McGimpsey, W. G. "Photochemistry of Upper Excited States and Excited Reaction Intermediates." *Trends in Organic Chemistry*. 1997, 6, 233-257.
- 3) McGimpsey, W. G. "Laser Induced Multiphotonic Processes in Polymer Chemistry" in CRC Press: *Applications of Lasers in Polymer Science and Technology* 1990.
- 4) McGimpsey, W. G. "Properties of Upper Excited States and Excited Reaction Intermediates" in CRC Press: *Handbook of Organic Photochemistry* 1989.

Patents

- 5) Benco, J. S.; Nienaber, H.; McGimpsey, W. G. "Device and method for the determination of lithium ion concentration in a biological fluid." US Patent Number: 7,214,538
- 6) McGimpsey, W. G. "Cyclic Peptide Structures for Molecular Scale Electronic and Photonic Devices" US Patent Number: 6,902,720
- 7) McGimpsey, W. G.; MacDonald, J. C. "Non-Covalent Assembly of Multilayer Thin Film Supramolecular Structures" US Patent Number: 6,893,716
- 8) Benco, J. S.; McGimpsey, W. G. "Ammonium Ionophore. An Ammonium ion selective matrix, an ammonium ion-selective sensor and a method for detecting ammonium ions in a fluid sample." US Patent Number: 6,746,595
- 9) Benco, J. S.; McGimpsey, W. G. Nienaber, H. "Potassium Fluoroionophore" US Patent Number: 6,660,526
- 10) Lambert, C. R.; McGimpsey, W. G. "Imagewise patterning of films and devices comprising the same." (Utility Application) (2006)
- 11) Lambert, C.R.; McGimpsey, W. G. "A Dual Transduction Method of Detecting Analytes." (Utility Application) (2005)
- 12) Cyganski, D.; McGimpsey, W. G. "Sub-Wavelength Photolithography" (Utility Application) (2004)
- 13) McGimpsey, W. G.; MacDonald, J. C. "Switchable Surface Wettability" (Utility Application) (2004)

Journal Articles

- 14) Soto, E.; MacDonald, J. C., Cooper, C. G. F.; McGimpsey, W. G. "Non-covalent Assembly of Photocurrent Generating Multilayered Thin Films." To be submitted.

- 15) Bush, K. A.; Driscoll, P. F.; Soto, E. R.; Lambert, C. R.; McGimpsey, W. G.; Pins, G. D. "Designing Tailored Biomaterial Surfaces to Direct Keratinocyte Morphology, Attachment, and Differentiation." *Journal of Biomedical Materials Research*. In press.
- 16) Driscoll, P. F.; Phewluangdee, M.; Soto, E.; Cooper, C. G. F.; MacDonald, J. C.; Lambert, C. R.; McGimpsey, W. G. "Photocurrent Generation in Non-Covalently Assembled Multilayered Thin Films" *Langmuir* In Press.
- 17) Purohit, N.; Wanichacheva, N.; Driscoll, P.; Lambert, C. R.; McGimpsey, W. G. "Reversible Photoswitchable Wettability in Non-Covalently Assembled Multilayered Films" *Langmuir* 2007, 23, 13181.
- 18) Emerson, R. J., IV; Bergstrom, T. S.; Liu, Y.; Soto, E. R.; Brown, C. A.; McGimpsey, W. G.; Camesano, T.A. "Microscale Correlation between Surface Chemistry, Texture, and the Adhesive Strength of *Staphylococcus epidermidis*" *Langmuir* 2006, 22, 11311.
- 19) Wanichecheva, N.; Soto, E.; Lambert, C. R.; McGimpsey, W. G. "Surface-Based Lithium Ion Sensor: An Electrode Derivatized with a Self-Assembled Monolayer." *Analytical Chem.* 2006, 78, 7132.
- 20) Wanichecheva, N.; Benco, J.S.; Lambert, C. R.; McGimpsey, W. G. "A Highly Selective Bicyclic Fluoroionophore for the Detection of Lithium Ions." *Photochemistry and Photobiology*. 2006, 82, 268.
- 21) Benco, J. S.; Nienaber, H. A.; McGimpsey, W. G. "A Highly Selective Fluoroionophore for the Detection of Lithium Ions: 9-Anthryl-Substituted Azacrown Ether Covalently-Linked to a 1,3-Alternate Calix[4]arene." *J Photochem. Photobiol. A: Chem.* 2004, 162, 289.
- 22) Cooper, C. G. F.; MacDonald, J. C.; Soto, E.; McGimpsey, W. G. "Non-Covalent Assembly of a Photoswitchable Surface." *J. Am. Chem. Soc.* 2004, 126, 1032. (Communication to the Editor)
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